

THE BRICKBUILDER

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No. 5.

A SKETCH OF THE LITERATURE OF CLAYS.

DURING the past five years the writer has had occasion to visit, in pursuit of information concerning clays, all of the important clay districts of the United States, and has been often asked by workers in clay where they might find literature of various sorts pertaining to clays. It seems, in consequence, that a brief paper on this subject will prove of value to many readers.

Clay publications may be classified, on the basis of the points of view of the various authors, into two general groups, as follows: First, industrial publications, or those works dealing essentially with manufactured clay products and with methods of manufacture; second, scientific publications, which deal with the occurrence of clays in nature, with their chemical and physical properties, and with their behavior when subjected to a variety of conditions.

The first group is made up, as a rule, of popular publications, museum reports on collections of pottery, etc., official reports upon exhibits at expositions, scientific journals, and periodicals published essentially for the "trade." Among the popular works are many written historically, either concerning the general history of special kinds of clay ware, or dealing with clay wares in general in special localities or countries. Others are confined to artistic discussions mostly in connection with ceramics, and to a less extent with architectural effects through the use of structural materials made of clay.

The second group is embraced largely by the reports of geological surveys; the journals, bulletins, and memoirs of various scientific societies, geological, chemical, and physical; and by a large class of scientific periodicals and industrial journals. Among these publications are a few monographs devoted entirely to the subject of clays, but chapters and paragraphs, scattered often through large volumes, constitute the greater part of them. A few private publications belong to this group.

There are, of course, some works which might with equal propriety be placed in either group.

INDUSTRIAL PUBLICATIONS.

Following the order of this classification, the writer presents below brief abstracts of such publications as seem to him to be most useful to the greatest number of people interested in clay, and which are at the same time accessible in most of the large libraries of the country, or can be readily obtained through any book-dealer.

"BIBLIOGRAPHIE CERAMIQUE,"

A LIST OF WORKS ON CLAYS, CLAY MANUFACTURERS, AND CLAY PRODUCTS.

Among the books classified as industrial, by all odds the most valuable publication is the "Bibliographie Ceramique," by Champfleury. It is a French publication, and claims to contain a classified nomenclature of all the publications made in Europe, America, and in the Orient, upon ceramic arts and industries since the sixteenth century up to the date of publication (1881). This work contains a preface, and introductory remarks of seventeen pages, describing the

magnitude of the task undertaken, the methods pursued, and the assistance rendered to the author by various students and writers. Following this, as Part I., is an alphabetically arranged bibliography, complete up to the date of publication, with the exception that the author left out of consideration, on account of the enormous scope involved, works touching upon prehistoric ceramics, and that of Greece and Rome.

In Part II. of the book, the alphabetical list of the first part is rearranged and grouped by countries, so that the reader can readily find, by referring to it, a work by a writer of any nationality. This work is so complete and comparatively so recent that it is hardly worth while in an article of this sort to attempt to describe any, in particular, of the great number of publications to which it refers. It is sufficient to say that any one desiring to make a study of clay industries either on the side of their manufacture, or that of art or history, should turn to it for assistance.

A PRACTICAL TREATISE ON

THE MANUFACTURE OF BRICKS, TILES, TERRA-COTTA, ETC.

In 1889 a second edition of a work by Charles T. Davis was published, which is entitled, "A Practical Treatise on the Manufacture of Bricks, Tiles, Terra-cotta, etc." The first chapter in this book is devoted to a sketch of the history of bricks, tracing it from the work of the Egyptians, between two and three thousand years before Christ, to the machine-made bricks of the present time.

The second chapter consists of general remarks upon the size, strength, and qualities of common and ornamental bricks, architectural terra-cotta, blue bricks, and the efflorescent exudation upon brickwork. The third deals with enamelling clays, ornamental bricks, tiles, earthenware, etc.

The remaining chapters are devoted to the consideration of various kinds of clays, methods of mining, washing, and marketing them, the manufacture of bricks by different processes, of descriptions of machinery, the discussion of kilns, fire-bricks, drain tiles, and sewer pipes, roofing and ornamental tiles, architectural terra-cotta, and methods of the manufacture of these various products. The book is liberally illustrated. For general and also much detailed information it is a valuable work to the manufacturers of clay products.

METHODS OF MINING CLAY.

Prof. J. C. Smock, the present State geologist of New Jersey, is the author of a paper of a few pages in Vol. III., Transactions of the American Institute of Mining Engineers, upon mining clay. He compares the method of mining by open workings in New Jersey, with those of mining by shafts and drifts, and gives a detailed account of what was, at the time of writing, a new mode of subterranean working for clays. Many of the difficult problems of mining through the clay and gravel beds of New Jersey are referred to, and much light thrown on their solution.

A GENERAL CONSIDERATION OF
BRICK PAVEMENTS.

"Brick Pavements" is the title of an article in the July number of the *School of Mines Quarterly* for the year 1891, by Werner Boecklin, Jr. This paper is briefly historical, and then passes on to the subject of clays, their preparation, and the burning and laying of the bricks. It discusses the cost and the methods of building foundations, the wear of paving bricks, their crushing strength and resistance to abrasion, and gives a table in which the relative resistance of brick and stone pavements is set forth. Their absorptive power is also dealt with, and the paper is closed with the comparison of forms of bricks and the advantages which they offer as a paving material.

FIRE-CLAY

AND ITS MANUFACTURE, MT. SAVAGE, MD.

Robert A. Cook, in Vol. XIV., Transactions of the American Institute of Mining Engineers, discusses the manufacture of fire-brick at Mount Savage, Md., one of the most important fire-clay districts in the United States. He gives a brief history of the fire-clay industry at that place, stating that it began in the year 1837, and then describes the clay bed and the methods of mining it from the earliest attempts down to the present methods. He describes the clay itself in considerable detail, gives an analysis, and enlarges on the subject of the treatment of the clay in the manufacture of brick, and the methods of moulding, pressing, drying, and firing. A description is given of a continuous rectangular gas kiln used at Mount Savage, and of the gas producer which supplies the gas. The author also devotes some space to the calculations in getting at the value of a fire-clay based on the work of Bischof, and to methods of testing the clays for different sorts of refractory bricks as carried out by the Union Mining Company, which employed Mr. Cook for making various tests, in order to keep the brick made by the company up to the highest standard demanded by the market. It is an interesting and valuable contribution.

THE FIRE-BRICK AND THE FIRE-CLAY OF SWEDEN.

In Vol. XIII. of these Transactions there is published a paper on the fire-brick and fire-clays of Sweden, which states that "the fire-clay district in Sweden is located in the northwest corner of the southern peninsula, where the material is associated with the only existing Swedish mineral coals." The development of the coal and clay has been greatly retarded by its distance of three or four hundred miles from the iron-producing centres. The paper deals with the history, geological occurrence and nature of the fire-clays, gives statistics of production and analyses. The cost, method of mining and manufacture are set forth in considerable detail. Besides its value in giving general information, the paper is a useful one to the manufacturer of fire-clay.

GENERAL DISCUSSION OF CLAYS

AND LIST OF SPECIMENS ON EXHIBITION IN THE UNITED STATES NATIONAL MUSEUM.

Frederick P. Dewey, in Bulletin XLII. of United States National Museum, 1891, has published an article on the collections in economic geology and metallurgy. On page 213 there begins a discussion of the clays, following which are tables of analyses, and one showing the wide range of application of clays, with a list of the samples of characteristic clays from different parts of the United States, which are there on exhibition.

CLAYS.

THEIR PREPARATION AND MANUFACTURE INTO VARIOUS PRODUCTS.

"Bricks and Brick-Making," is the title of a work published in 1889, by Alfred Crossley. It is a revised reprint of an article in the *Brick, Tile, and Pottery Gazette*. It is devoted to a discussion of clays and their preparation, and the making, repressing, and drying bricks. It has also a chapter on fire-clay goods and bricks for refractory purposes. It is a pamphlet of sixty pages, with numerous illustrations, well written and full of information.

REPORT ON CLAYS AND
CLAY PRODUCTS AT THE VIENNA INTERNATIONAL
EXHIBITION, 1873.

There are two reports published by William P. Blake, on "Ceramic Art" and "Ceramics" respectively, of which the former is a report on pottery, porcelain, tiles, terra-cotta, and bricks, with table of marks and monograms, and notice of distribution of materials for pottery, and a chronicle of events in the history of pottery manufacture. It was first published in a volume of reports of the Massachusetts Commission to Vienna International Exhibition of 1873, and afterwards republished by Van Nostrand of New York, in 1875.

It is a remarkably interesting discussion of the clay products at that exposition, and abounds in descriptive matter, historical facts, and accounts of methods and machinery. It contains also a list of titles of works on pottery and porcelain, which were consulted by the author. As a whole, it is an exceedingly valuable treatise on the subject, but is scantily illustrated.

REPORT ON THE
CERAMIC EXHIBIT AT THE PARIS UNIVERSAL EXPOSITION,
1873,

AND DISCUSSION OF THE MANUFACTURE OF FIRE-BRICK.

The article entitled "Ceramics," by the same author, was published in Reports of U. S. Commissioners of the Paris Universal Exposition of 1878. It contains a list of the awards made, and a list of the exhibitors of the different countries. There is much descriptive text concerning the exhibits, with numerous beautiful illustrations. It concludes by quoting verbatim a paper on the manufacture of fire-brick, by James Durmachie, read at the meeting of the British Association, held at Glasgow, September, 1876. There is much in this report concerning clays and their products which is well worthy the consideration of clay manufacturers, whether they make artistic or structural products.

GEOLOGICAL SURVEY REPORTS.

The publications on clays by the different State Geological Surveys of this country have, until within the last few years, been very meagre, but are now becoming more numerous. They are usually as much "industrial" as "scientific," and so, perhaps, do not fall under the head of one of these groups more properly than the other.

THE CLAYS AND CLAY INDUSTRIES OF NEW JERSEY

AND COMPARISON OF AMERICAN WITH EUROPEAN CLAYS.

In this country the first important consideration of clays was undertaken by the State Survey of New Jersey, and a report was published in 1878 by George H. Cook, State geologist, and his assistant, John C. Smock. It is a comprehensive work of over three hundred and fifty pages, and describes exhaustively the clays and so-called kaolins and felspar deposits of the State, setting forth clearly their geographical and geological occurrence, and describing in detail the different clay beds and the specific mines and pits of the various operators in the State.

All this matter is contained in Parts I. and II. In Part III. there is a discussion of nearly fifty pages of the composition, properties, and origin of the New Jersey clays, with a table of analyses. In Part IV. the economic uses are discussed for making pottery, refractory materials, building materials, and for miscellaneous purposes. Part V. is a chapter on exploring, digging, mining, and marketing clays. In an appendix is a list of American clays examined by the Survey for comparison with those of New Jersey clays. This contains also a similar list of British, French, Belgian, and German clays. There are numerous analyses of clays, from this and other countries, and a large number from New Jersey.

It was the first valuable and instructive work of its kind published in this country.

THE CLAYS AND CLAY INDUSTRIES OF OHIO.

The Ohio Geological Survey published, in 1884, in Vol. V. of

its reports, an article entitled "Economic Geology," by Edward Orton, Jr., on the clays of Ohio and the industries dependent upon them.

The first chapter is devoted to the consideration of the origin, composition, analysis, and properties of clay, and a table giving fifty-three analyses, three of which are from Ohio. The second chapter describes clay deposits of Ohio, first taking up drift clays, and then so-called bedded clays of the coal measures. Following this section is one devoted to the clay-working industries of Ohio, discussing those of pottery, stoneware, earthenware, whiteware, fire-brick retorts, glass pots, linings and tile, pressed tile and glazed tile, roofing tile, fire-proofing, pipe-making, drain pipe, sewer pipe, encaustic tiling, ornamental pottery, and terra-cotta.

EXHAUSTIVE TREATISE ON

THE CLAYS AND CLAY INDUSTRIES OF OHIO.

This same Survey, in consideration of the great importance of the clay industries in Ohio, has but recently published in Vol. II., Part I., of its reports another and more exhaustive treatise on the clays and clay industries of the State. It is in two parts; the first, which deals with the classification, composition, and origin of clays, is a concise and well-arranged article from the pen of Prof. Edward Orton, State geologist. The second part is by Edward Orton, Jr., and is devoted to the clay-working industries of Ohio. The first section of this part is entitled "A General Consideration of Clays." It deals with their origin and composition, both chemical and physical, describing in detail the various chemical and mineral impurities found, and their effects on the clay as it is treated in various ways for various purposes. Next in order is discussed properties, taking up in turn its plasticity when wet, permanence when burnt, and its refractoriness or ability to stand high and long-continued heat without fusion or loss of form.

Then follows a discussion of the changes occurring in clay by burning, which is full of points valuable to the clay manufacturer concerning the various difficulties in the way of preparing and burning the clay, the author laying great stress on the necessity of correctly burning clays. This is followed by a few pages of text concerning the testing of clays.

Section II. is devoted to the present condition of the clay-working industries of the State. It is subdivided in general into the manufacture of pottery, of paving material, of pipe and hollow goods, refractory material and building material. It is too long an article and too full of facts, ideas, and suggestions to be treated of more at length here. This report, it may be confidently said, will prove of great value to those seeking from its pages information on any of the subjects treated.

A BRIEF, GENERAL, AND HISTORICAL DISCUSSION OF

CLAYS AND KAOLINS,

WITH ESPECIAL REFERENCE TO THOSE OF CALIFORNIA, AND TREATISE ON POTTERY.

The State of California, through its State Mining Bureau, has made some contributions to the literature of clays, the best of which are to be found in two papers in the Ninth Annual Report of the State Mineralogist, published in 1890. One of them, entitled "Clays," by W. D. Johnson, chemist of the State Mining Bureau, consists of a very intelligently written discussion of clays and kaolins in general, of fire-brick and fire-clays, with especial reference to those found in California, and of a treatise on the subject of pottery. The paper is briefly historical, and then deals with the industry as it exists in California, and the clay beds on which it is founded, the author stating that at the date of writing upwards of \$1,000,000 was invested in the pottery business in that State. He enlarges upon the method of treating and preparing clays in various countries, and also describes at length, in connection with tables of analyses, samples of important Japanese clays.

The other paper in this report is a very entertaining and instructive article on pottery, by Linna Irelan. It includes a classification of pottery and porcelains, and a history of some celebrated porcelain. It also treats of decoration, painting, and firing, with tables of pastes.

CLAYS AND CLAY INDUSTRIES OF MARYLAND.

Maryland, which is famous for its fire-clays, has recently published, through its Board of World's Fair Managers, a volume of some five hundred pages, in which is a chapter on the clays of the State, by Prof. G. H. Williams. It is a division of the subject of mines and minerals of Maryland. The distribution of the clays, and the clay industrial operations, embracing the manufacture of building brick, terra-cotta, and tile work, fire-brick, and pottery, are dwelt upon. The output of bricks of all kinds in Baltimore is stated to average 150,000,000 annually.

DISCUSSIONS OF

ALUMINUM ORES, CLAYS, AND BRICK PAVEMENTS.

There are several articles of interest to the clay worker and clay student in a report of the Geological Survey of Georgia, entitled "The Paleozoic Group." One of these is on aluminum ores and the sources of aluminum, including an account of bauxite, kaolin, clay, and halloysite.

Another paper is devoted to clays and brick pavements. It discusses the clays of Northwestern Georgia under the following headings: "Composition of Clays," "Kaolin Type," "Residual Clays," "Clays from Disintegrated Shales," and "Alluvial Clays," gives tables of analyses and devotes a number of pages to the consideration of brick pavements in general, and the kinds of clay required for them. It compares in an interesting way the merits and relative cost of bricks, street asphaltum, and granite blocks, as road material. There is also considerable information on the subject of clays in a chapter on the formation and characteristics of soil in the Paleozoic belt of Georgia.

A DISCUSSION OF CERTAIN MISSOURI CLAYS, AND

THE CLAY INDUSTRIES OF ST. LOUIS AND KANSAS CITY.

In the Bulletins of the present Geological Survey of Missouri, three papers dealing with the clays of different sections of the State have been published by George E. Ladd. The most useful of these is entitled "The Clay, Stone, Lime, and Sand Industries of St. Louis City and County," in Bulletin No. 3. It describes the different clays, geologically and in detail, gives a descriptive list of clay works, including those producing fire-clays, etc., sewer pipes, terra-cotta, pottery, and structural bricks. It contains a few illustrations and statistical tables.

Within the area discussed the value of the clay products for the year 1889 is shown to have been as follows: Structural brick, \$2,288,795; fire-clays, sewer pipes, and pottery, \$1,722,685; giving a total value for the clay and rough clay products for the city and county of St. Louis, for one year, of over \$4,000,000, figures so striking as to seem worthy of insertion here.

In Bulletin No. 1, in "Notes on the Building Stones, Clays, and Sands of Certain Counties in Southeast Missouri," a few descriptive and statistical notes of the kaolin and clay industries of that region are published, and in Bulletin No. 5, an account of the clays and clay industries in the country immediately tributary to Kansas City is also published.

THE CLAY MATERIALS OF THE UNITED STATES.

The study of clays is just beginning to receive the attention which is its due in this country, and besides the reports on the subject by the different States mentioned above, there are monographs on clays either already for publication or nearly so by other States. Among these are Arkansas, Indiana, Iowa, Missouri, and Texas, and it is probable that still others, through their Geological Surveys, will soon begin special investigations concerning the clays and clay industries within their domain.

The United States Geological Survey has published, since 1882, annual statistical works entitled "Mineral Resources of the United States," which contain valuable statistical information in regard to the production, importation, and manufacture of clays. In the report of this series for the calendar year 1891, published in 1893, there is a

paper by Prof. Robert T. Hill on "The Clay Materials of the United States." Following several statistical tables, the author discusses the commercial classification of clays, their origin and natural classification, and describes the sedimentary clays of the geological formations, passing from the oldest to the most recent in sequence. He then describes the occurrences of clay materials by States. The paper covers fifty-four compactly printed pages and has the best summarized statement concerning the United States clays which has appeared in print.

Among the periodicals devoted to clay and its products, published in this country, are, first, of course, this journal, *THE BRICKBUILDER*, which here speaks for itself, then the *Clayworker*, and the *Brick, Tile, and Terra-Cotta Gazette*, the last two being published in the West.

With this mention of periodicals the sketch of clay literature classified in a general way by the writer as "Industrial Publications" is brought to an end, and the attention of the reader is called to the second group, or "scientific publications."

CAMBRIDGE, MASS.

G. E. LADD.

(To be concluded in June number.)

BRICK AND MARBLE IN THE MIDDLE AGES.

(Continued.)

CHAPTER V.

"Am I in Italy? Is this the Mincius?
Are these the distant turrets of Verona?
And shall I sup where Juliet at the masque
Saw her loved Montague, and now sleeps by him?"
—Rogers.

PALAZZUOLO — COCCAGLIO — BRESCIA: NEW AND OLD CATHEDRALS — BROLETTO — CHURCHES — DONATO — DESENZANO — LAGO DI GARDA — RIVA — TRENT — VERONA.

OUR drive from Bergamo to Brescia was strikingly unlike what we had hitherto been so much enjoying. Mile after mile of straight roads, between fields so closely planted with fruit-trees that one never sees more than the merest glimpse of anything beyond them, are certainly not pleasant; and the hot sun above us, and the thirsty and dry beds of rivers which we crossed on our way, made us feel glad when evening drew on, and we found ourselves rapidly nearing Brescia.

I made notes at two or three places on the way. At Palazzuolo is a great circular belfry, ornamented with a large figure at the top and divers others about its base, built of brick rusticated to look like stone, and altogether about as base a piece of architecture as could well be found, but pardoned here because of the pure blue of the sky I saw behind it, and partly on account of the view which it commands, reaching, it is said, as far as Milan, and including the great plain out of which, upon a slight hill, it rises. Palazzuolo is nicely situated, and upon the first of the many rivers which we had passed from Bergamo which had any water in its bed. The houses, too, were almost all supported on arcades, giving pleasant shelter from the sun.

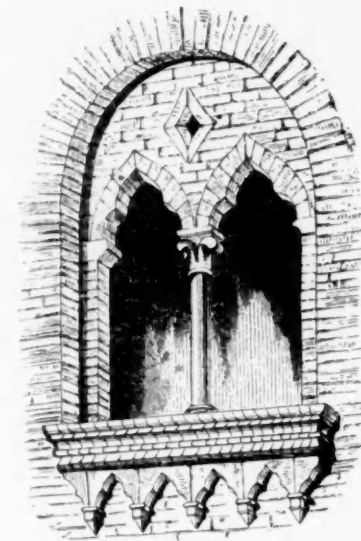
Beyond this we came to Coccaglio, a small village with a wretchedly bad modern church, glorying in a glaringly sham front, and faced on the opposite side of the street by the remains of a mediæval church, whose place it has taken, and which is now shut up and rapidly going to ruin. The new church is built north and south, the old one orientating properly; but then the west front was the great feature of the new church, and therefore it was necessary, of course, to place it towards the road.

Coccaglio still has, however, some very valuable remains of mediæval domestic work in its houses, of which I was able to obtain some sketches. They were entirely executed in brick and terra-cotta, except, of course, the capitals and shafts of the windows, and appeared to be of the fourteenth century.

The upper portion of the house, of which I give a sketch (page 79), remains very fairly perfect, though its lower story has been entirely modernized. It will be seen that it is very uniform in its design, the large and small windows alternating regularly; and that semicircular arches are used in the windows in connection with oggee trefoils. This is one of the apparent inconsistencies which occur in almost all Italian Gothic work, and might seem to give us ancient authority for

any amount of license in our combination of the elements of what we ordinarily consider to be thoroughly different styles. The windows are marked by the same elaboration of their sills which we noticed in the Broletto at Bergamo, and the detail of these, as also of the corbelling out from the wall of several chimney-breasts, is exceedingly good.

In a back street in the village I found a house, the balconies around which were corbelled forward on finely moulded beams, which, judging by the moulding, could hardly be of later date than the commencement of the fourteenth century.

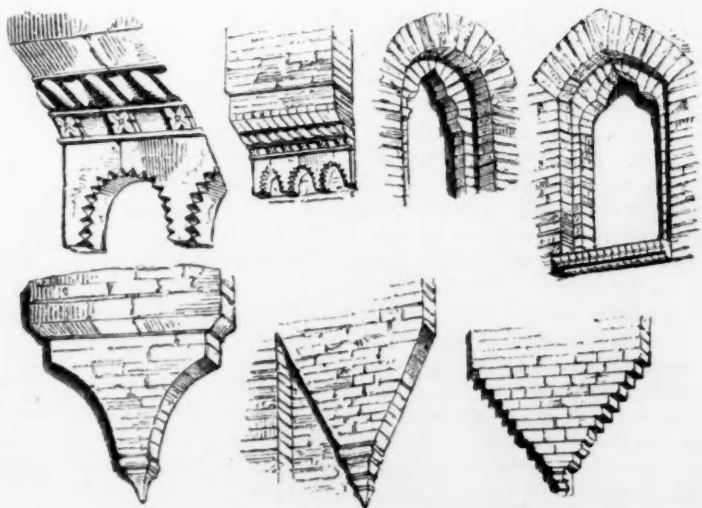


WINDOW — COCCAGLIO.

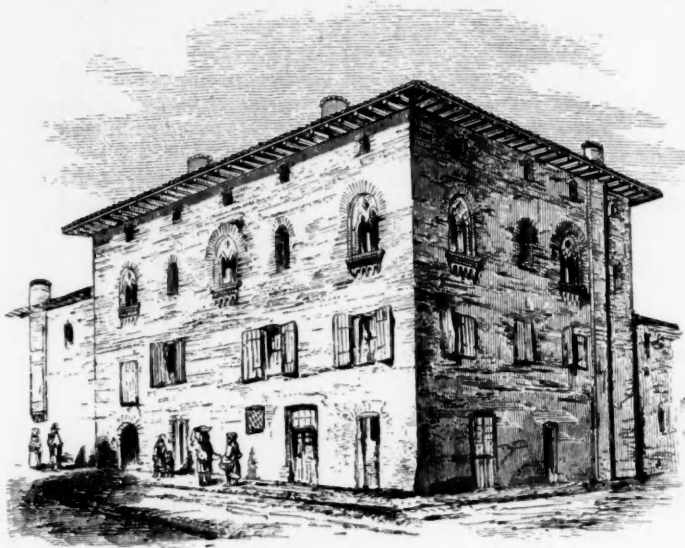
Wooden buildings of this kind are much rarer in Italy than they are in the North, and I particularly notice this little relic, therefore, which still remains to show how well the science of moulding was sometimes understood even there.

Such a village as Coccaglio is, as I found afterwards, a place to be made much of; for generally, except in public or important buildings in large towns, one sees very little trace of any mediæval domestic work beyond the perpetually recurring arcading under the houses, which is so general a feature in all the towns in the north of Italy.

There is nothing further of any interest on the road, and just after sunset we reached Brescia, too late to see anything of the general effect of the city.



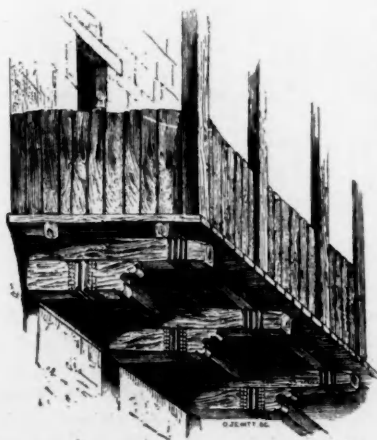
DETAIL OF WINDOWS AND CORBELLING FOR CHIMNEYS—COCCAGLIO.



HOUSE AT COCCAGLIO.

Brescia is mainly famous, I believe, first for its connection with a story of the generosity of Bayard, the "*chevalier sans peur et sans reproche*," and next for the large discoveries of Roman remains which have from time to time been made there. It is one of those towns, moreover, of which guide-books, with an immense list of churches and the pictures they contain, give, perhaps, too grand an idea before they have been seen. It is, however, undoubtedly a place of much interest, not only for the antiquary, but also for the student of mediæval art, since, though its churches are generally uninteresting, it has in the Broletto, sadly mutilated and modernized as it is, the remains of one of the most extensive and grand of these buildings, and to a considerable extent executed in very excellent brickwork.

Our first visit in the morning was to the Piazza, in which stand the two cathedrals—the old and the new—side by side, and just beyond them the front of the Broletto, stretching its great length up a slight hill and along a narrow lane beyond the Piazza, whilst at its angle, towering up between it and the cathedrals, stands a tall and rugged stone campanile, without break or window, until at the top, where, just as in the corresponding tower at Bergamo, great rudely arched openings are left, through which appear the wheels and works of the bells.



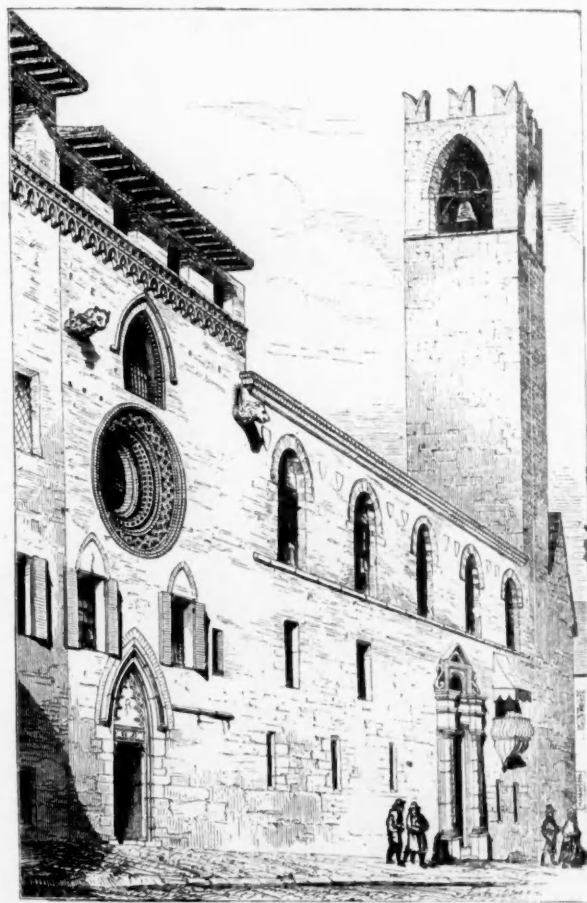
WOODEN BALCONY—COCCAGLIO.

The new cathedral, approached by a flight of steps from the Piazza, has a great sham front. It has, moreover, a large dome, said to be inferior only in size to those of St. Peter's and the cathedral at Florence, but not prepossessing in its effect; nor did the church seem to contain any pictures of value. By a descent of some twenty steps from the south transept the old cathedral is reached. This is of very early date, and constructed partly in stone and partly in brick. The

most remarkable feature is the nave, which is circular in plan, with an aisle round it; the central portion, divided by eight arches from the aisles, being carried up into a dome. The choir and transepts are projected on the east side of the dome, and the former is groined and has a five-sided apse. The walls retain some fair mediæval monuments, and beneath the church is a large crypt. The old stone altar in the choir is a fine example of the thirteenth century. The mensa is, as so often is the case, carried on shafts, no less than sixteen in front and six at the ends, with carved capitals. The stalls are in the apse, and a fine lectern stands behind the altar.

The whole air of the Duomo Vecchio is chill and dismal to a degree; it is neglected and dirty, and apparently shut up except for occasional services, and left no pleasant impressions on our minds of our first Lombard cathedral; and yet undoubtedly there is both here and at Aachen—where the plan of the cathedral is so very similar—much to admire in the idea of the plan, and I can quite imagine that a very noble and useful church might in any age have been founded upon this old Lombard type.*

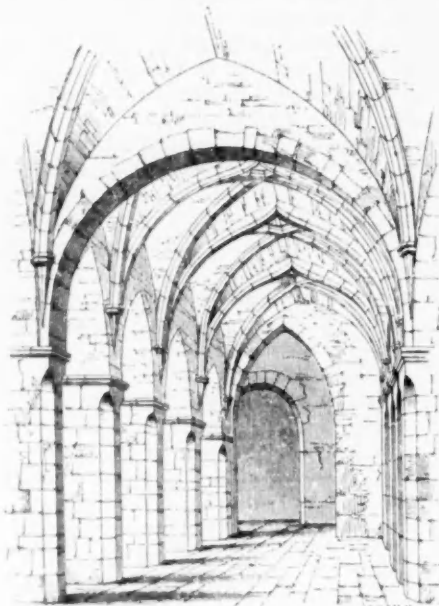
Those who know anything of Spanish churches will be reminded here of the two cathedrals at Salamanca, the relative positions of which are just the same, a steep flight of steps in either case leading down from the south aisle of the new cathedral into the old and deserted one.



BROLETTO, BRESCIA.

*S. Gereon, at Köln, is a magnificent example of a church upon the same kind of plan; a grand choir projected from a decagonal nave, the effect of which is capital. No doubt such a nave does much more than merely suggest the possibility of adapting the dome to Gothic buildings.

From the cathedral we went at once to the Broletto, which stands in the same Piazza. The main portion of this immense building appears to have been built rather early in the thirteenth century. The



CLOISTER — BROLETTO, BRESCIA.

arches throughout are both round and pointed, used indifferently; but this mixture does not betoken any diversity of date, as it would in England. A large quadrangle is formed by the buildings, which has a cloister on two sides, and traces of another cloister on a third side now built up. The cloister still remaining on the east side is ancient and on a large scale; it opens to the quadrangle with simple pointed

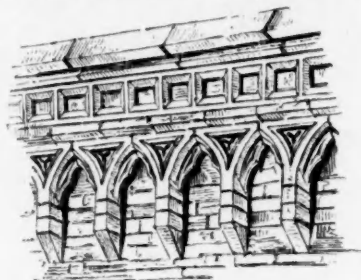


DOORWAY — BROLETTO, BRESCIA.

arches resting upon heavy piers, and a row of piers running down the centre divides it into two portions, so that it may be judged that its size is very considerable. The groining has transverse and diagonal ribs, the former being very remarkable, and, as not unfrequently seen in good Italian work, slightly ogeed; not, that is to say, regular ogee arches, but ordinary arches with the slightest suggestion only of an ogee curve in the centre. Of the external portion of the building the west front is the most perfect, and must always have been the finest; it consists of a building containing in the upper story five windows, the centre being the largest, and possibly once the Kingheira, to the south of which rises the great belfry of rough stone, and beyond that a wide building with traces—but no more—of many of the original windows; north of the building with the five windows is a very beautiful composition executed almost entirely in finely moulded bricks; it has an exquisite door with some traces of fresco in its tympanum, executed mainly in stone, of which I give a drawing, and a magnificent brick rose window, above which is a brick cornice, which continues over the remainder of the west front and along the whole of the north side.

The size of the building is prodigious, and certainly the detail of all the parts (excepting perhaps the cornice, which is of the common arcaded kind) is most beautiful and valuable. The brickwork is so good and char-

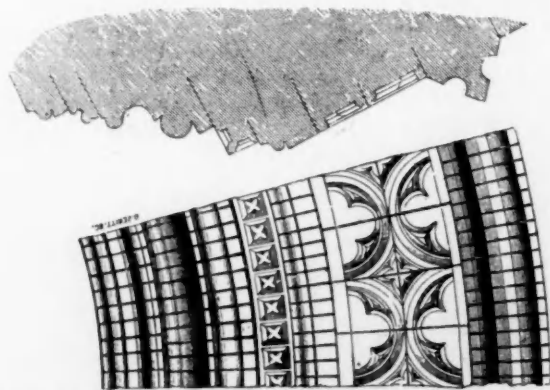
acteristic that I have given several sketches of it. All the arches have occasional voussoirs of stone, and the centre of the arch is always marked by a keystone, and these are sometimes slightly carved to distinguish them from the other stone voussoirs. The abaci are of brick, moulded and very varied. The doorway given in the woodcut on this page has stone jambs, caps, and bases, lintel and outer arch, the label and cusps being of terra-cotta; above this the whole of this portion of the front is of brick, and very admirably built.



BRICK CORNICE — BROLETTO, BRESCIA.

Of the churches of Brescia there seems to be but few of any interest; that of San Francesco, of whose west front I give a sketch, is the best, and, though not of uncommon design, is worth notice; the mixture of white and black marble and brick is very judicious, but I must protest once more against the arcaded eaves-cornices which are very elaborate and heavy; nor can I bring myself to like the great flat gable, covering both nave and aisles, and divided only by pilaster strips, which characterizes so many mediæval Italian churches. In this west front of San Francesco the cornices and the mouldings of the small circular windows are all of brick, and the rest of the front of stone, the rose window having voussoirs of black and white marble. The only other part of the church which appeared to be of any interest was a campanile on the south side of the choir; this had stone belfry windows, well treated with simple plate tracery, and there is a singular and lofty lantern over one of the chapels on the north side of the church, all of rich brickwork dating from about 1480.

The sun was at its hottest as we wandered about the streets of Brescia; but there was so much pleasure in the examination of the busy people who thronged its narrow, tortuous streets that we enjoyed it very much. In Italian towns, too, there is not much difficulty in finding the way; we ask the road to some church, and forthwith, in place of a long and not very intelligible direction, in which we are sure entirely to confuse our right hand with our left, the person we ask turns round with us, walks by our side, shows us our object, and,



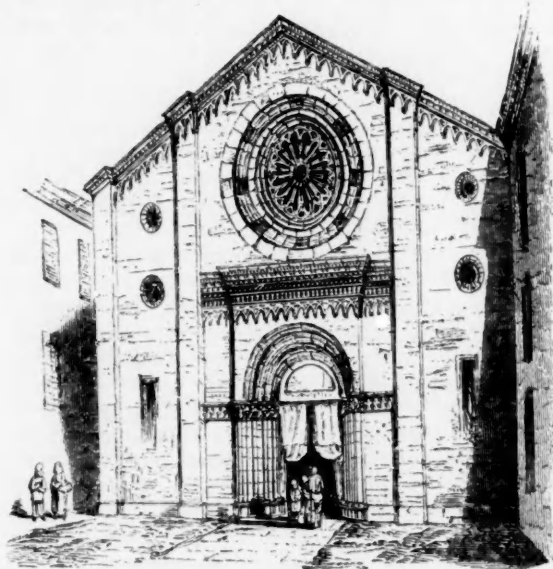
DETAIL OF CIRCULAR WINDOW — BROLETTO, BRESCIA.

politely taking off his hat and bowing, takes leave of us. It was by such aid as this that we found the church of the Carmine, which is another very late Gothic church. The west front is most fantastic and unpleasing, and the pinnacles, composed of round bricks, disposed alternately over each other, and common in most Italian brick buildings, are very ugly; there is, however, a good simple cloister attached to the church on the north; it is of the same design as almost all in this part of the world, having simple round shafts with carved caps

and circular arches. An inner cloister, which I remember of old as occupied by the ever-present Austrian soldiers, is now (1872) open to all the world, and neither cared for nor used. Here the south side of the cloister is of two stories in height, the lower similar to the one just mentioned, the upper having two arches to one arch of that below, and the arches picturesquely shaped, being cinquefoils, with the central division of ogee form, and with moulded terminations to the cusps. There is a fair campanile here, with brick traceries and strings, but with a modern belfry-stage.

A little bit of cloister, or gallery, on the north side of Sta. Afra, has arcading of similar character in its upper gallery, but the arches are trefoiled.

In the Contrada della Pace there remains a very bold fragment of a castle tower. It is built of roughly jointed stone, and is perfectly plain till near the top, where it has a bold machicolation with



SAN FRANCESCO — BRESCIA.

tall square angle-turrets, the whole battlemented with a forked battlement. Out of the centre of the tower a tall, thin tower rises to some height above the battlements.

One of the most picturesque spots in the city is the Piazza, at the end of which stands the Palazzo della Loggia; the effect on coming into it from the narrow streets in which we had been wandering was very pleasant, the large open space being surrounded with rather elaborate Renaissance work with rich colored sun-blinds projecting from the windows over the sunny pavement, which in its turn was thronged with people in picturesque attire selling fruit and vegetables. The streets are all arcaded, and some of them have very considerable remains of frescoes on the exterior, giving much interest to the otherwise ugly walls; they have, however, suffered very greatly from exposure, and are only in places intelligible; still they give traces of brilliant external color, and are therefore much valued in my recollections of Brescia.

Compared with Bergamo, Brescia has the air of a smart and busy place; its streets are wider and better paved, and the smells which still greeted us were not quite so bad as there. The staple manufacture of the city seems to be that of copper vessels; shop after shop, indeed street after street, is full of coppersmiths' shops; the men all sitting at work, and keeping up a ceaseless din of hammering, in open shops, so that all the world may see them. Nor is the coppersmiths' the only trade that loves publicity, for here, as elsewhere, the barbers' shops are very amusing, quite open in front, with perhaps a yellow curtain hanging down halfway, affecting only to conceal the inviting interior, which, however, is always sufficiently visible, occupied in the centre by a chair, on which sits the customer

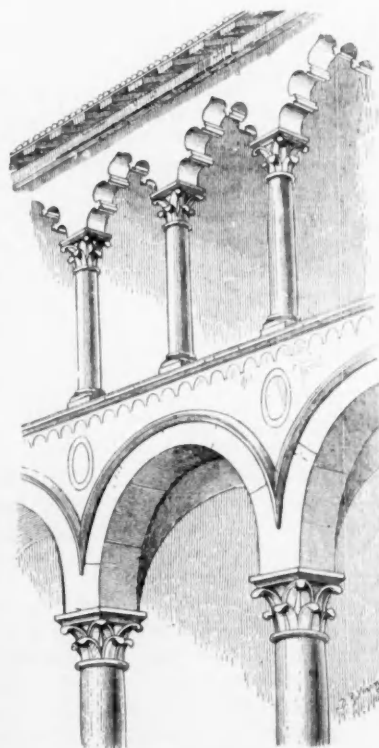
gravely holding a soapdish to his chin whilst the barber operates; and this going on all day makes one think that shaving is, after all, one of the great works of an Italian's time!

When we left Brescia the heat was intense; the road, too, was deep in dust to an extent not to be understood in England. There had been a drought of some weeks' duration, and the much-travelled road from Milan to Verona, along which our way now lay, plainly told the tale which the dry, parched, cracked-looking earth on each side of our way, and the sad faces of every one as they talked about the failure of the vintage, amply confirmed. Unluckily for ourselves, we had not taken the advice of our driver to have a close vehicle, but had insisted upon having an open carriage, the consequence of which piece of self-will was that we had hard work, even with the aid of umbrellas, to protect ourselves from *coups de soleil*. We now learnt that in hot weather in Italy it is not always the best plan to have as much of the sun as one can get. In England it always is, but he who acts on his English experience in Italy will surely repent his mistake.

We managed, however, to exist through the clouds of dust, relieved perhaps by the sight of a regiment of swarthy and unpleasant-looking Austrian soldiers, marching through the sun and dust, many of them with their knapsacks and arms, but all with great-coats on to preserve their white uniforms. When we saw them we could not help contrasting our relative lots, and then, feeling how much worse off they were than ourselves, we went on a little more contentedly than before. The road, too, became slightly more interesting; instead of miles upon miles of straight lines, we had a more winding way, and, after a time, occasional beautiful glimpses of the mountains, which marked to us the situation of the Lago di Garda.

We drove without stopping through Donato, a place of no interest apparently, save for the huge dome of its church, and then passing under a very fine viaduct resting upon a long range of pointed arches (which carries the railway, which soon after our return was opened, and now whisks only too many travellers from Milan to Venice and back without a halt on the way), we commenced the descent towards the town of Desenzano, beyond and above whose roofs stretched the beautiful expanse of fair Lago di Garda, with its great calm surface, and fine group of distant mountains hemming in with picturesque and irregular outline its upper end.

We soon reached the poor and desolate streets of the town, and, diving into the dark court of the not over-clean-looking hotel, gave ourselves up for a time to the contemplation of the quiet loveliness of the scene. The contrast between the flat shores of the lower part of the lake and the mountains which crowd around its head is very striking, and to this it is that Desenzano owes all that it has of inter-



CLOISTER OF THE CARMINE CONVENT — BRESCIA.

est. We strolled out for a short time, looked at washerwomen kneeling in small tubs on the edge of the lake, and washing their linen upon the smooth face of the stones which pave its shore, and then went on, as in duty bound, to look into the church. This we found to be neither very old nor very interesting, but curious as illustrating the extent to which, in Italy, the practice is sometimes carried of putting altars in every direction without reference to their orientation. Here the high altar and some others faced due south, whilst most of the remainder faced east, and I think scarcely one turned to the west.

The remains of an old castle rise picturesquely above the little harbor, from which steamboats sail for the tour of the lake, and, bidding farewell for a time to dusty roads, let us embark on one of these for Riva, at the head of the lake, on our way to Trent, which is, artistically speaking, the northernmost really national city and cathedral in Italy.

Our steamboat kept to the west side of the lake, touching at a few villages and towns, and for the most part ploughing its way along beneath some of the highest and most precipitous rocks that I know. We took a hand on board on the way, and discharged them into a big barge under a cliff, on the top of which was being held a village festa, at which they were to perform; and we all looked with no little compassion upon the heavily weighted performers as we saw the people who had preceded them climbing the steep mountain sides above us.

The Lago di Garda seems to me to be in its upper reach one of the most beautiful of Italian lakes, but it should always be taken in the way we went, for the contrast between the sublimity of the upper end and the tameness of the lower end is so great that nothing but disappointment would be felt by those who saw the head of the lake first.

One or two of the towns on the western shore have churches of some interest.

At Salò there is a Gothic church with windows which have a wide external splay and an enriched brick moulding or label all round them. The windows are of one light, and have ogee-cusped heads. Another church, at (I think) Gargnano, is of much more importance. It is cruciform, with a domical lantern at the crossing. The nave has a simple clerestory and aisles, and the west end, built in black and white courses, has one great arch which encloses the doorway, above this a lancet window, and above this again a circular window without tracery.

From Riva—one of the most pleasant resting-places on the Italian lakes—a good road through fine scenery leads to Trent, a journey of some six or eight hours. The descent upon Trent is very fine. The town standing by itself well away from the fine mountains which form the background to the view, the old walls and towers around it,

and the interest of the cathedral and other buildings behind them, combine to give a sense of the importance and grandeur of the city which the facts of the case hardly justify. Perhaps, too, there is something in the historical importance of the place which, without one's knowledge, sways the judgment.

There is, in fact, only one building of great architectural importance, the cathedral; but, as I shall show, it has the greatest interest, not only on account of its real merit, but also because it is a startling example of the way in which in the thirteenth century* the Lombard architects adhered to their old lessons and habits in spite of all the developments which were then universally accepted on the northern side of the Alps.

The church is a round-arched building throughout, but the mouldings and details everywhere show a knowledge of thirteenth

century work, and have none of the character of true Romanesque or Lombard art. Yet at the same time there is in many respects a most close imitation of Lombard features. There are arcades under the cornices of the aisles, arcades under the eaves of the apses, open porches supported on shafts whose bases rest on monsters, and other features which, looked at apart from the sections of mouldings and details of sculpture, might well warrant a much earlier date being fixed on for the execution of the work than I have named. An inscription which fixes the date of some works here in 1212† may fairly, I think, be assumed to give the date of the greater part of the fabric, though some portions, as *e. g.* the western wheel window and the northern porch, are probably not so early by at least a hundred years. But I am not concerned to deal with the question only from an archaeological point of view, and will at once therefore go on to give some description of the building.

The ground plan is in the shape of a Latin cross, with an eastern apse, two small apses to the east of the transepts, and a nave and aisles of seven bays. There is an octagonal lantern over the crossing, and the whole church is groined. The doors are, two in the east walls of the transepts, one at the west end (of marble), and one with a projecting open porch over it near the east end of the north aisle. Two western towers were intended to be built, and the staircases to them are carried up in the western and southern aisle walls in a very unusual and picturesque fashion. They



DUOMO, TRENT.

* I say this advisedly, though knowing very well that some German antiquaries assert this cathedral to have been built in the time of Bishop Ulrich II., A. D. 1022-1055. Those who say so must, I think, be entirely blind to all architectural detail.

† Anno Domini MCCXII. ultima die Februarie presidente venerabile Tridentino Episcopo Frederico de Vanga, et disponente hujus Ecclesie opus incepit et construxit magister Adam de Arognio Cumane Dioc. et circuitum ipse, sui filii, inde sui Aplatini cum appendiciis intrinsece et extrinsece istius ecclesie magisterio fabricarunt. Cujus et sue prolis hic subtus sepulcrum manet. Orate pro eis.

commence in the third bay east of the towers, and are carried up in a continuous rise, opening to the church with a series of arches stepping up to suit the level of the staircases. The western bay to which these stairs lead is groined at a lower level, as well as at the nave level, so as to form a very lofty gallery open to the church.

The clerestory consists of very small windows, and there is no triforium, the main portion of the columns goes up to and carries the groining, and, though the main arches are all semicircular, there is nevertheless an evident attempt, and it is successful, to give an impression of height to the interior. The continuous arcades under the eaves are carried also across the front of the transepts, and give a great effect of richness to the external architecture. Of the two towers only one is complete, and this was built in the sixteenth century. The northern porch is the only place in which the pointed arch appears, and it seemed to me to be of the fourteenth century, though the doorway is of Lombard character, with very quaint but poor carving in its tympanum, of Our Lord, with the four evangelists. The whole church is built of stone, and has a classical want of life and vigor, which one notices only too often in the best Lombard work. Were it not for the building attached to its northeast angle, I suspect the general impression would be much less agreeable than it is. This is a lofty erection with two square turrets and a small apse at the east, parts of which seem to be earlier than the date I have given to the cathedral. It is connected with the northeast angle, but its axis is not parallel with that of the cathedral, and there is consequently a good deal of picturesqueness in the perspective, besides which it prevents the otherwise insipid outline of the whole building being perceived.

The porch on the east side of the south transept, of which I give an illustration, is one of the most interesting portions of detail in the building. Its front is supported on two shafts, one of which is an octagon resting on the back of a lion, the other four shafts cut out of a single block and ingeniously knotted together in the centre, and resting on the shoulders of four sitting figures—altogether about as strong an illustration of mediæval love of change and variety as could be found. It must have been the work of a sculptor who was just a little savage with the somewhat tame uniformity of the whole of the architectural scheme of the cathedral.

I found little else to see in Trent. Sta. Maria Maggiore has a Romanesque steeple, quite plain below, but with its two upper stages arcaded, the arcades resting in the lower stage on shafts coupled one behind the other, and in the upper tripled in the same way. I do not remember before to have seen this last arrangement. A tower in the walls between this church and the cathedral is a rhomboid in plan, and was, I suppose, built of this strange shape to suit some necessity arising out of the position of streets and walls. Considerable portions of the walls remain; they are of stone, finished on the top with the forked Italian battlement, and having square projecting towers at short intervals.

Trent Cathedral and the fine church at Innichen in the Pusterthal are quoted frequently as the two finest churches in Tyrol. That at Innichen has not the same entirely Italian character which marks that at Trent. In the latter I always feel that climate, people, and town are all in concert to make one suppose oneself in Italy, which certainly is not the case at Innichen. North of Trent the architecture of the Tyrol (as at Botzen and Meran) is entirely German, whilst in Trent itself, were it not for a steep roof here and there covered with bright glazed tiles, and a few such slight indications, no one would suspect the presence of any German influence whatever.

I have travelled so frequently from Trent to Verona by the railway that I always regard it as one of the most natural and obvious roads of approach to Italy for Englishmen. It takes its course through so fine a country that one does not easily tire of the journey, and finally, it sets travellers down in the city which, perhaps more than any other in Northern Italy, charms the cultivated traveller by the beauty, interest, and grandeur of its buildings. Who that has taken this way to Verona does not remember with pleasure the last quarter of an hour of his journey, as the railway, making a circuit round two

thirds of the city, reveals first a mixed group of lofty steeples, presently the great church of San Zenone, then Sta. Anastasia, anon San Fermo, then crosses the swift-flowing Adige, and at last lands one at the station, full of anxiety to make the nearer acquaintance of the buildings of "*Verona la degna*," which from afar look so wondrous brave and fine?

(To be continued.)

THE ART OF BUILDING AMONG THE ROMANS.

Translated from the French of Auguste Choisy by

ARTHUR J. DILLON.

PART ONE.

OF ROMAN CONSTRUCTION WITH SMALL CEMENTED
MATERIALS.

CHAPTER I.

METHODS OF BUILDING ROMAN MASONRY.

DURING several centuries Rome had no architecture strictly her own; the monuments of her first days were raised under the direction, and, perhaps, even by the hands of Etruscan artisans, and were but masses of rough or hewn stone laid always without mortar. When later she passed from the tutelage of the Etruscans to that of the Greeks, she changed the form but left the substance as it had been in the beginning, and up to the last century before the Christian era her builders still used the same great blocks of dry-laid stone. This method of construction, where each block evokes the idea of a difficulty overcome, was too fit an expression of Roman power to be cast aside when Rome reached the zenith of her greatness; nor was it ever entirely abandoned. The columns of granite in the monuments of the Empire, those heavy and massive monoliths that received the thrusts of the great vaults, the ponderous blocks of cut stone in the walls of the amphitheatres, and all the pompous revetments of their great edifices, clearly showed that, notwithstanding the change in style, the architects still held to the old traditions learned in the Etruscan school. But the practical mind of the Romans, their instinctive tendency towards simplification in all things, impelled them to make a more profitable use of their immense resources. Instead of composing the body of their edifices of great blocks laboriously piled up, they sought by less expensive methods to develop resources until then unknown, and they originated the general use of irregular materials broken to bits and bound together by mortar.

Whether this idea of composing monolithic masses by the agglomeration of small chips and fragments of stone is to be attributed to the Romans, or whether it is to be carried back to the Etruscans, or, like so many other inventions, even to the ancient Egyptians or Assyrians, it remains certain that never before the Roman epoch had the use of such elements been conceived of as the basis of a general system of monumental construction; the Romans first appreciated all the advantages that so simple a means offered to art; they first used it methodically, adapting it with rare sagacity to varying needs, and, profiting by the facility with which rubble of fragmentary material and mortar can be composed, even of the most diverse substances, they made its use almost universal and utilized it at all points of the Empire with almost equal success. The materials they used were confined to no one spot; the most shapeless bits of stone, splinters of hard rock least fit for cutting, the slightest fragments which to-day would be cast aside in the debris of the quarries, were sufficient for their greatest undertakings. The manual labor was the simplest; the edifices composed of a plastic material could, as it were, be modelled at the will of the architect and raised by hands most unaccustomed to the arts of building. The execution of their work required only an expenditure of

force; lacking skilled masons, the slaves, the armies, the population subject to forced labor, filled the needs of the workyards, where the most difficult operations were reduced, as we shall later show, to spreading the beds of mortar and laying the fragments of stone on them in uniform courses.

I propose in this chapter to give the details of the process of making that agglomeration of mortar and small stones of which the Roman masonry was constituted. But before doing so it is necessary to mark very plainly the distinction between two sorts of masonry which resulted from two distinct and clearly characterized processes, and which have never, as far as I know, been employed indiscriminately. The distinction I wish to make clear is that which resulted from the part compression played in the construction of Roman masonry, which had, one might say, peculiar characteristics, and was used for special purposes, according to whether ramming was or was not used. We will first take up the rammed masonry, the manner of its preparation, and the circumstances which determined its use, and to make this clear, we will take, as an example, an ordinary mass of it, a straight wall, for instance, with vertical faces.

RAMMED MASONRY.

The following figure will aid in the explanation of the processes followed by the Romans in laying rammed masonry; it represents

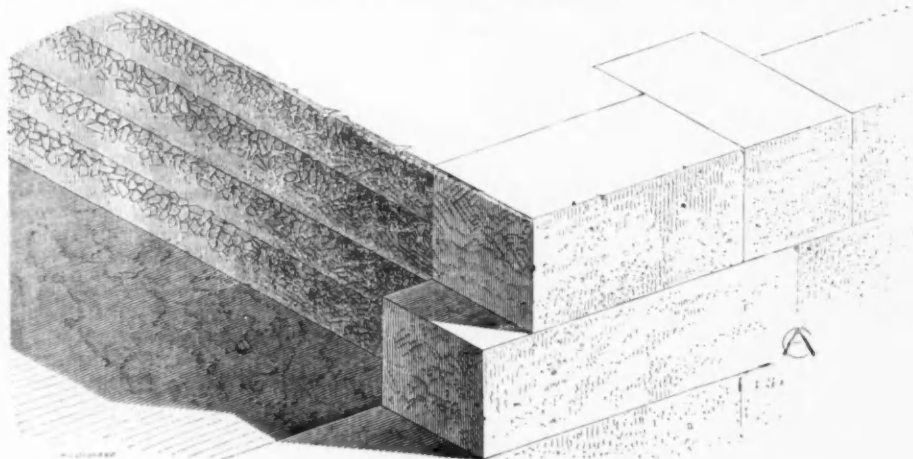


FIG. 1.

an imaginary section through a thick mass comprised between facings of large cut stones. The method was as follows: Between the stones forming the facing of the wall they spread a thick bed (ten to fifteen centimetres) of mortar, made, in Rome, of lime and puzzolana, elsewhere of lime and coarse sand. Upon this they spread with the shovel fragments of stone reduced to the size used in making modern roads, that is to say, capable of being passed through a ring of about eight or ten centimetres in diameter. When the beds of stone reached a thickness equal to or slightly greater than that of the bed of mortar, they rammed it thoroughly, with the effect of forcing the mortar into all the interstices. These layers, each bed of stone being rammed, alternated throughout the height of one course of the facing; when the top level of each course was reached, the workmen threw on the bed of small stones the dust resulting from the dressing of the facing and then rammed more thoroughly than before; the mortar under this compression found its way into all crevices, but, thanks to the presence of the dust, it was impossible for it to rise to the surface and adhere to the tools and feet of the workmen. The same series of operations, — spreading a bed of mortar, covering it with broken stone and ramming, — was continued along the line, and a mass of rubble, such as we have described, might be likened to a rammed embankment composed, however, of successive layers of mortar and small stones. Thus were built the masses of nearly all the tombs along the roads near

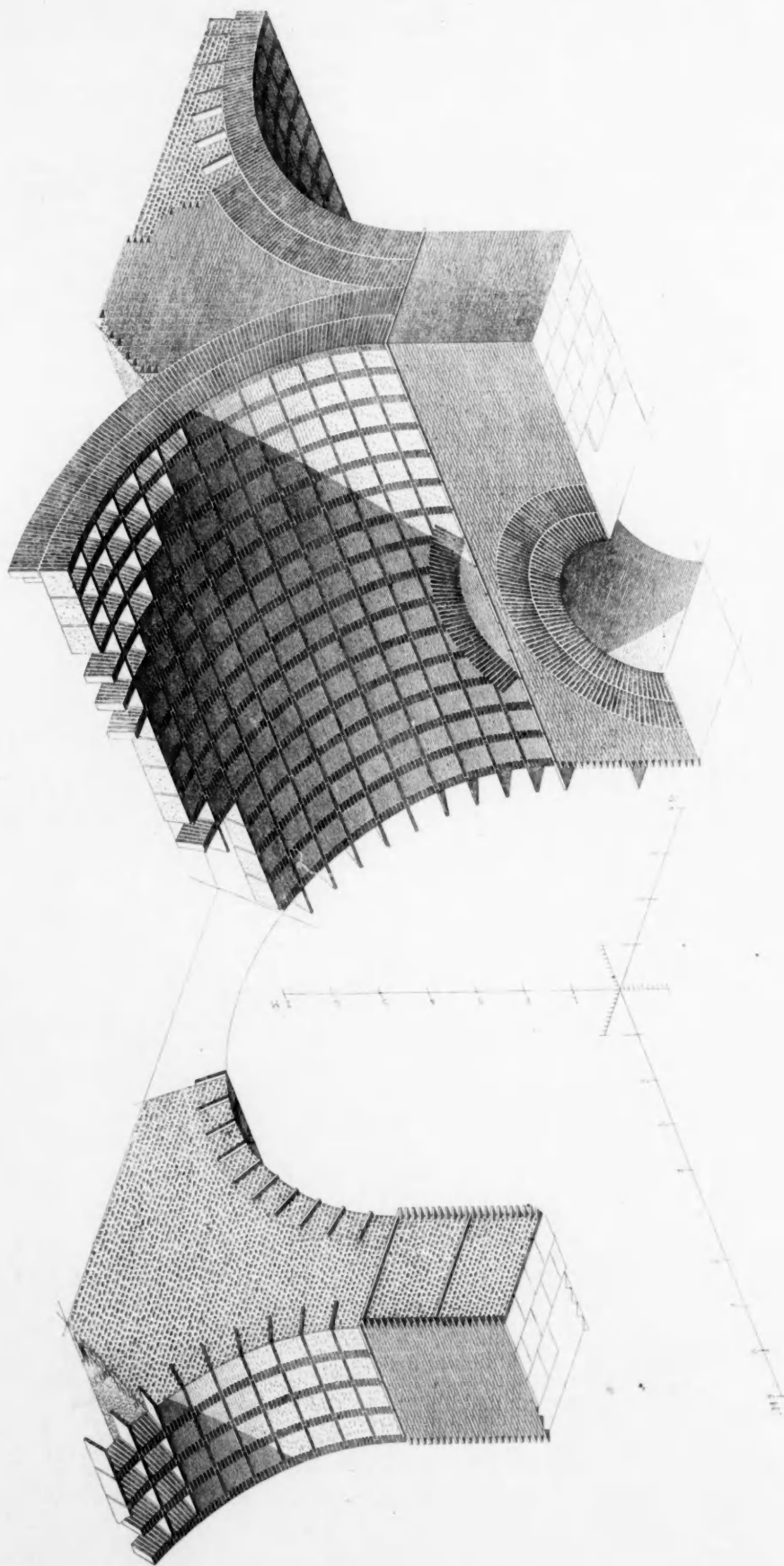
their entrance into Rome, particularly those along the Appian Way. The material employed was sometimes fragments of compact tufa, sometimes splinters of black lava, which could be quarried at a short distance from the works. In examining these ruins, one cannot mistake the system of their construction, and, with a few exceptions, it was the system that I have described. Thus one can distinguish, in the sections of the masses, courses of mortar, and courses where the broken stone predominates; the fragments pressed together near the surfaces where the compression was applied, and here and there partially crushed by the shocks or by mutual friction, while others pierce with their sharp points the beds of mortar that hold them. Moreover the horizontal planes of compression can be so clearly distinguished that it is, I think, impossible not to recognize in the ruins the progress of a systematic ramming.

Aside from this use of tamped masonry in cores with stone revetting, the only other employment of it that I know is in the substructures of Roman edifices, and this application suggested itself naturally. The soil of the Roman Campagna is composed of volcanic products, more or less united, so that it is feasible to make the walls of excavations vertical, provided that a slight sheathing is used to maintain them. Thus the excavations themselves afforded an extremely firm mould in which the masonry could be rammed, a circumstance that the Romans put to profit in building the foundations of their principal structures; and, with few exceptions, the subterranean masonry of their monuments is composed of thick and thoroughly rammed beds of mortar.

Such are the substructures of the so-called Circus of Sallust, and such, also, are the walls which now support the terrace against the Basilica of Constantine; these walls must not, however, be regarded as built expressly for retaining the earth. The walls for this purpose have fallen, leaving bare these formerly subterranean ones, which were originally nothing else than the foundations of edifices long since destroyed. Similar decay has brought into view ancient foundations in the circuit of the Palatine, which would also be taken for retaining walls, but which were in reality constructed of rammed masonry in sheathed trenches and have served to hold the earth only since the real retaining walls were overthrown. To the same system belong, at least in part, the fillings-in made by Hadrian to support the platform of the Temple of Venus and of Rome. Wherever the substructure of the platform was built beneath the surface, wherever the excavations for them afforded a natural mould, the Romans made the masonry of alternate thick beds of small stones and mortar united by compression.

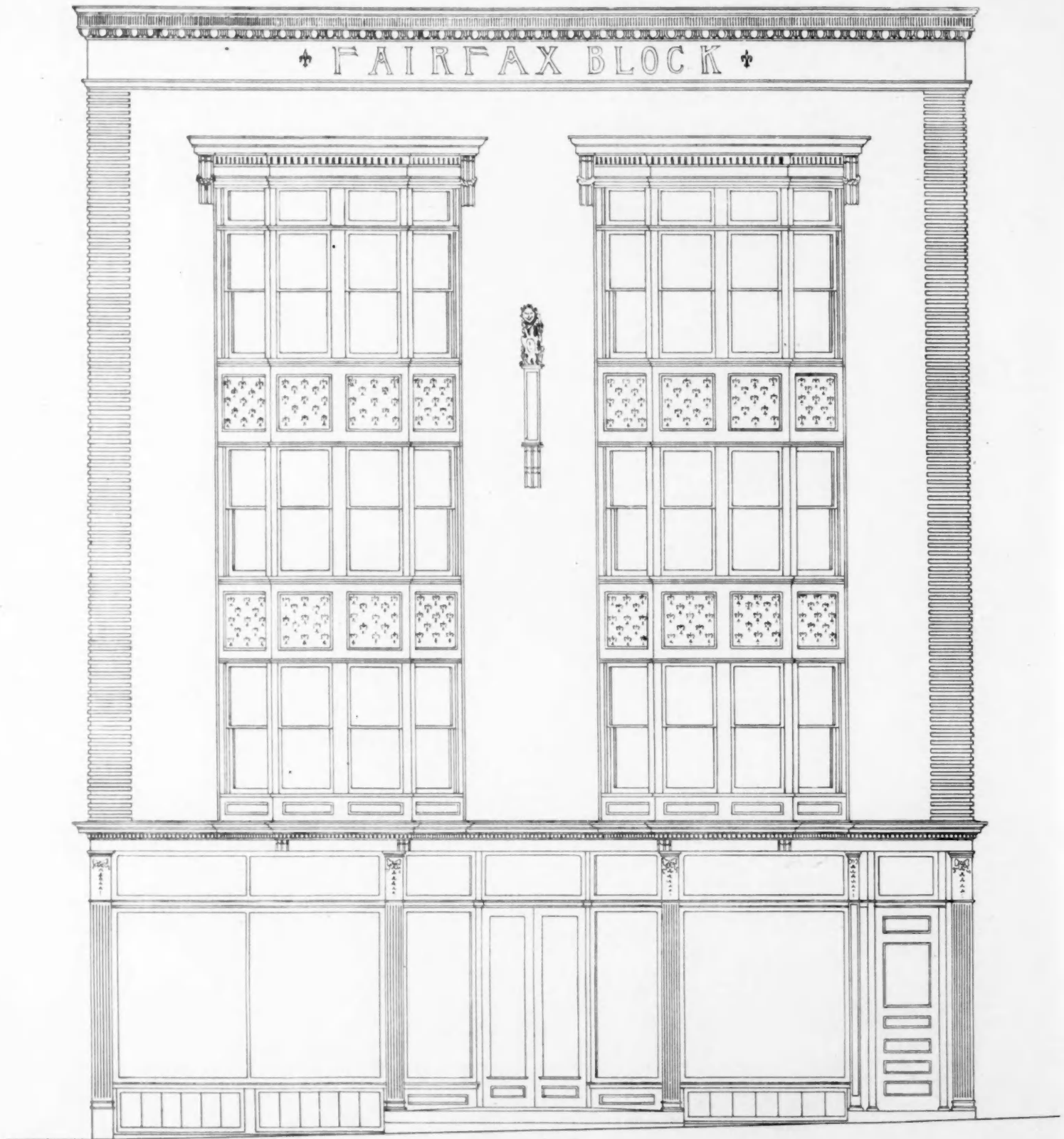
Let us finally cite, as perhaps the most remarkable example of this work made by ramming in sheathed trenches, the foundations recently discovered by the excavations in the Farnese Gardens. They may be regarded as a type, and an attentive study of them would permit the restoration of the forms of the previously cited works, some of which are much defaced. I have tried in Fig. 2 to give the actual appearance of these foundations and that which they presented at the time of building. The marks of the boards and of the uprights of the sheathing are very clearly imprinted, and one has but to imagine the wood replaced in the impression to find, point for point in every detail, the arrangement of the sheathing as represented in the lower part of the drawing. The uprights against which the planks forming the revetment of the trenches leaned marked in the foundations deep vertical grooves, and the position of the planks can be distinguished by long horizontal streaks of mortar. Often the mortar forced by the ramming has penetrated

the spaces between the stones, and the mortar forced by the ramming has penetrated



THE ART OF BUILDING AMONG THE ROMANS.

See article on page 83.



BUILDING FOR MESSRS. FAIRFAX BROS., GENEVA, N. Y.

NOLAN, NOLAN & STERN, ARCHITECTS, ROCHESTER, N. Y.

DRAWN BY J. MILLS PLATT.

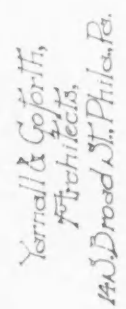


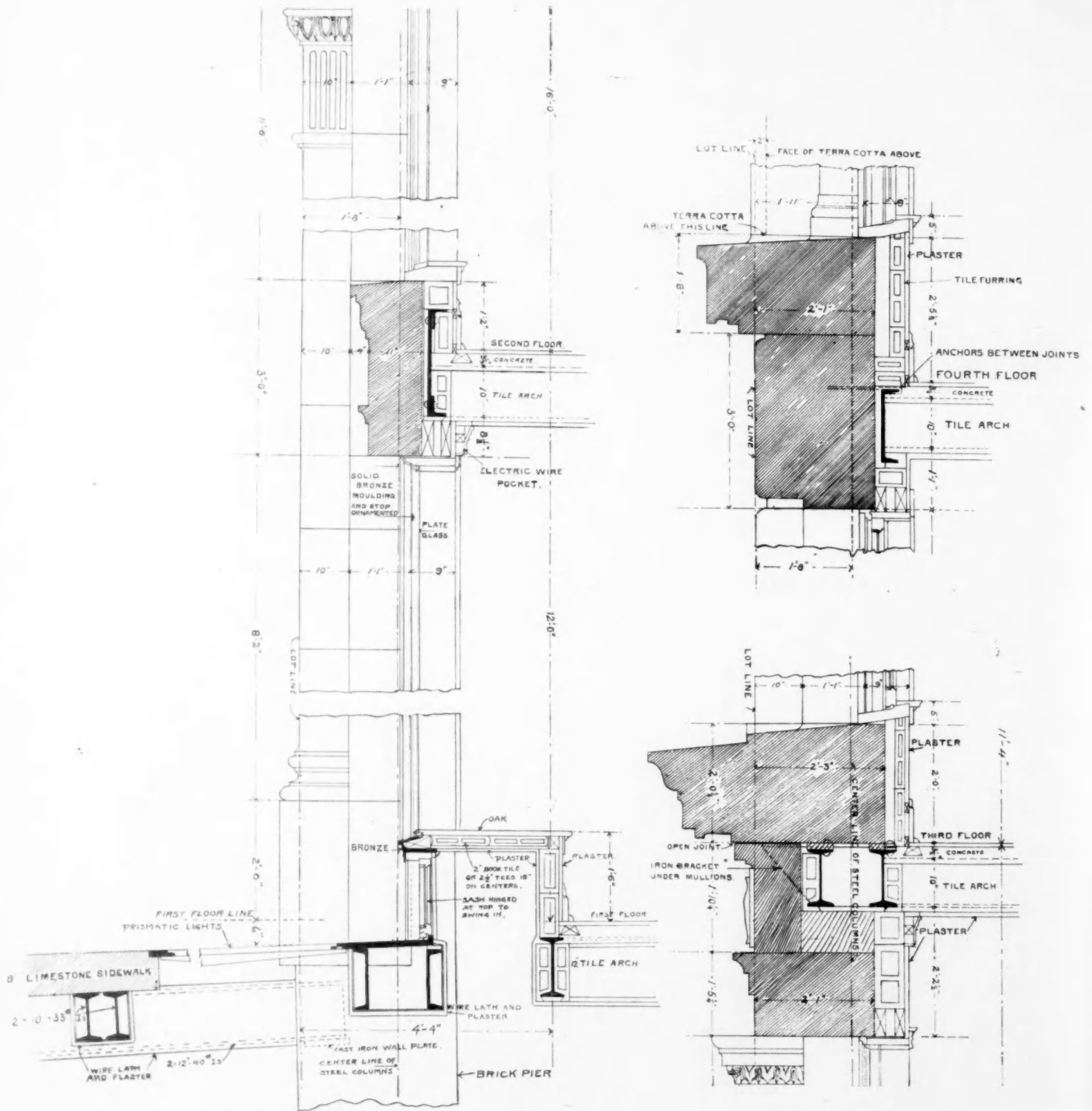
BY PERMISSION OF "THE INLAND ARCHITECT."

NEW YORK LIFE BUILDING, CHICAGO.

JENNEY & MUNDIE, ARCHITECTS.

See article in Fireproofing Department.

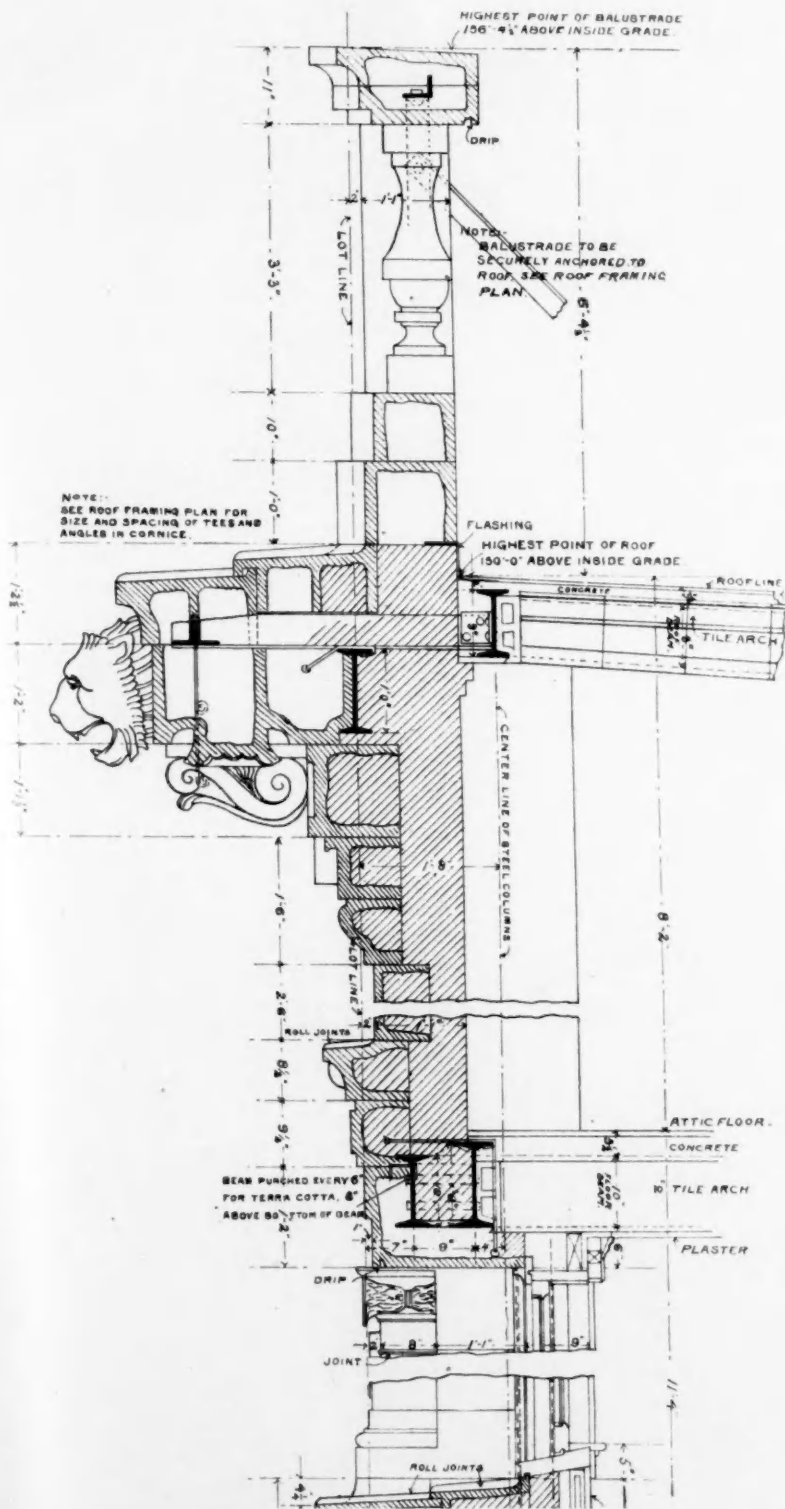




SECTION THROUGH 1ST STORY STORE
FRONT AND 2ND STORY BANK WINDOW
IN GRANITE FACED WALLS.

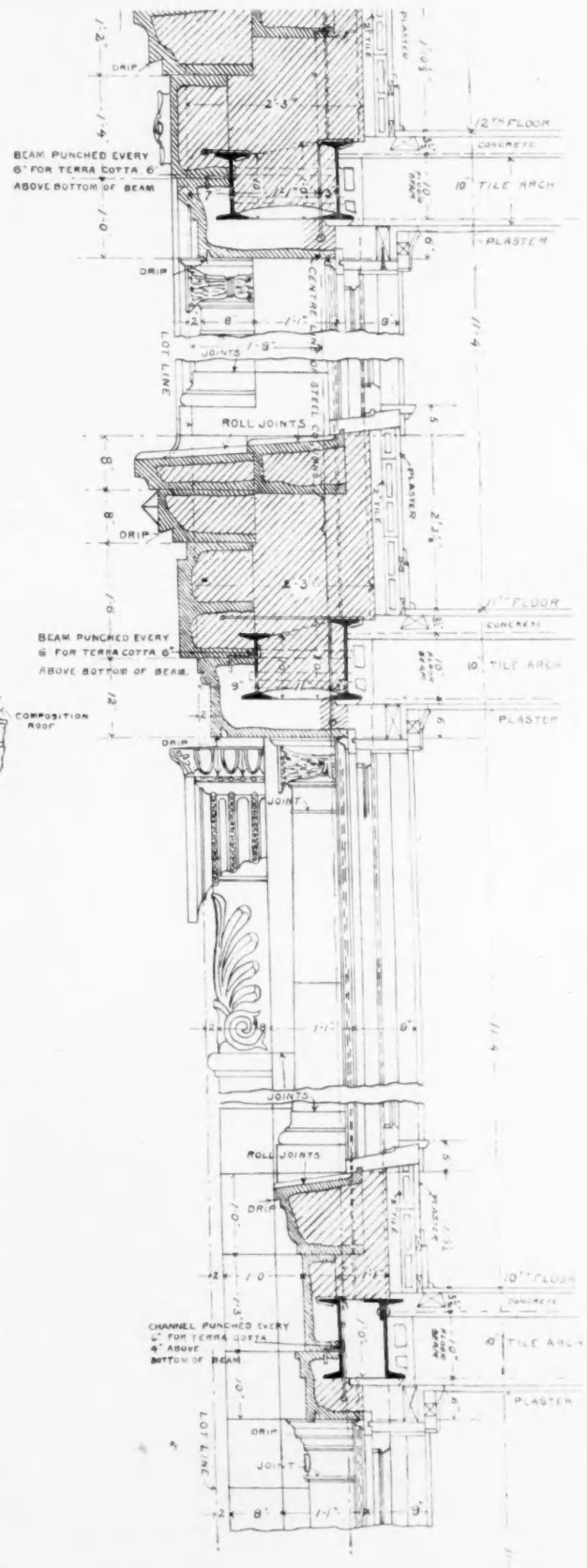
DETAILS OF FIREPROOF CONSTRUCTION.

See page 91.

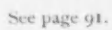


DETAILS OF FIREPROOF CONSTRUCTION.

See page 91.



SECTION THROUGH TERRA COTTA FRONTS



through the interstices of the sheathing to the walls of the trench, where it hardened in flattened ridges; the boards were moulded in these leakages and rotted in place, leaving an imprint whose sharpness demonstrates the energy with which the masonry was rammed.

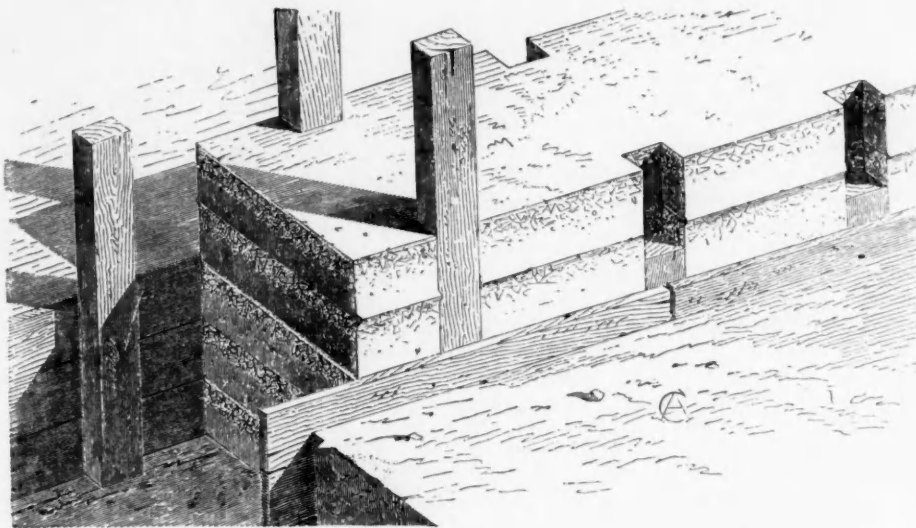


FIG. 2.

As to its composition, the rammed masonry of these foundations is like that which we described in speaking of walls with revetments of stone, except that here layers of dust are entirely absent. But this circumstance is easily explained, for the dust was employed only to utilize the debris made by the cutting of the stone revetments, and its presence between the beds is, so to speak, incidental, and constitutes but a very secondary difference between the two principal uses made by the Romans of rammed masonry.

MASONRY LAID WITHOUT RAMMING.

The rammed masonry we have just examined was laid rapidly and its workmanship was very simple, a double advantage which the Romans appreciated better than any one else. It does not always appear that they were very anxious to make its employment general. They adopted it, as we have said, for walls with revetments of stone, or for subterranean work; but, except for these special cases, rammed masonry was, so to speak, not in use, and it is the second kind of construction still to be described, which must be looked upon as the usual method of ancient Rome.

I do not believe it necessary to explain this new system by a drawing in detail. One can get a clear enough idea of it by turning to the section of a wall pictured in Plate 33. In the first system which we studied, beds of fifteen centimetres of mortar alternated with similar layers of broken stone; in the second, on the contrary, each stone was laid directly on a bed of mortar; in other terms, the new style of masonry was an ordinary rubble, and was not distinguished, by any essential characteristic, from modern rubble. Imagine the beds of mortar a little thinner, and the stones larger, and the kind of work we are studying does not differ from rough rubble such as is made to-day. In rammed masonry, fragments of stone are found in all possible positions, on their natural bed or otherwise indifferently, and the only order existing in the mass resulted from the distribution of stones in large horizontal layers separated from one another by deposits of mortar. The ordinary masonry, on the contrary, shows none of these irregularities; it is a very regular super-position of beds of mortar, at most three or four centimetres thick, alternating with courses of small stones, each piece being laid flat on its natural bed, and, if sometimes broken tiles or the debris of potteries were used in place of splinters of stone, the arrange-

ment of their faces, following the horizontal plane, is always plainly evident.

There is a rather widespread opinion that this ordinary kind of masonry is a sort of beton; that is to say, a mixture of stone and mortar, prepared beforehand and poured on together; but the regular

position of the pieces of stone, which are invariably placed with their largest dimensions following a horizontal plane, forbids, I think, this hypothesis. Such an opinion would become even more improbable, if one took into account the size of the stones in the walls. It is not rare to find them from twelve to fifteen centimetres in length by seven centimetres in thickness. I noticed quite a number at the Basilica of Constantine, the Baths of Diocletian and of Caracalla, the Temple of Venus and Rome, etc., which were at least this size. At the Baths of Agrippa I measured some even larger. To spread a mixture of mortar and stones of this size would be, to say the least, a difficult operation.

A last remark will, perhaps, appear even more conclusive. Notwithstanding the care the Romans took, they did not always succeed in filling with mortar the vertical joints between

the pieces of stone in the same course. The fragments are but incompletely enveloped by the mortar; in other words, the bed on which they lie and that which covers them did not penetrate far enough into the vertical joints to fill them, and halfway up there remains a gap. Such gaps would never have existed if the materials had been mixed beforehand and poured on together. These spaces are as a rule not easily seen; nevertheless they are not at all singular or exceptional defects, and there are few monuments in Rome, even among those which date from the best epochs, in which they cannot be pointed out.

We have, therefore, sufficient foundation for concluding that beton was not the ordinary masonry of ancient walls. But one must not conclude from this that the Romans were ignorant of its composition and use. Vitruvius speaks of beton in unmistakable terms. He advises its use, for instance, for sub-aqueous works built without coffer-dams. Nothing, however, in the terms which he uses indicates that he means to describe a material in current and general use, and, in fact, the Romans were too wisely economical not to prefer the masonry we have just described to beton, which, without an increase in durability, would have involved a noticeable increase in expense. Their ordinary masonry, as we have said, was enough like beton to be confounded with it, but it must have been much cheaper. The mixture of the stones and mortar requires a certain expenditure of labor, and is a difficult task which the Romans sought to avoid. Hands were not lacking to make the preparation in quantities, but it seemed to them useless, and, instead of making the mixture beforehand, they made it in place. The small stones and the mortar were, perhaps, not so well united, but the regular arrangement made up in part for this defect. All the virtues of their ordinary masonry can be summed up by saying it had all the advantages of beton, and allowed the saving of a great part of the labor which would have been necessary for its preliminary mixture.

On the whole, it may be said that the ordinary masonry of the ancients had for its essential principle the employment of small stones and mortar unmixed; but one can go further and show more in detail the manner of making it.

If, for example, one examines attentively a ruined Roman wall, one can perceive that the beds increase and diminish in thickness, in a slow but regular manner; and this appearance of the beds of mortar

is significant, for it shows that the material was spread over large surfaces, which were covered with stones as they were extended, and that the mortar was then thrown on from a shovel, accounting not only for the regular undulations of the beds, but, at the same time, for the presence of the unfilled spaces, or air holes, which were sometimes to be seen about the middle of the vertical joints. Hence, if it is admitted that the mortar was spread in large continuous beds in this manner, the entire procedure at the works is, we may say, explained; one body of workmen with shovels spread the mortar, and another without delay pressed the stones in the bed thus prepared. The work was thus divided into two distinct operations, a division which, at the same time, accelerated its progress and guaranteed its orderly execution. I give this organization of the Roman work only as a conjecture; but the theory has at least the advantage of completely explaining the appearance of the interior parts of the masses of masonry, and, moreover, it accords quite happily with the organizing character which the Romans showed in all the details of the enterprises they directed.

We can now compare the two methods of construction we have illustrated, and seek the motives which, according to circumstances, determined the use of one or the other. As we shall see, they were purely motives of economy, and show how much consideration the Roman architects gave to practical questions.

The Romans sought, first of all, to reduce the time and cost of their work; they feared the least complication or hindrance in the yards, and avoided, through principle, and I might almost say, by system, all work which led only in an indirect way to the end they had in view. Now, rammed masonry can be employed only on the condition of providing temporary moulds; the compression of a mass of the rubble permeated with semi-fluid mortar causes horizontal thrusts in the direction shown by the arrows in Fig. 3; that is, with a

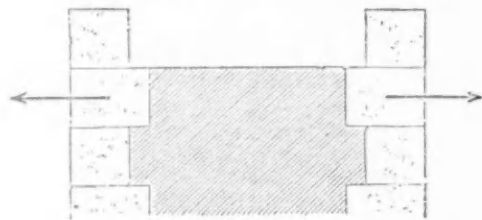


FIG. 3.

tendency to push the revetting walls outward. If, then, the revetment does not in itself have a sufficient stability, it is necessary, in order to apply sufficient ramming, to re-enforce the wall with a supporting scaffolding, with a sort of exterior sheathing or casing. In this there is a complication which the ancients sought to avoid, and with this view they invariably observed the following rule: whenever they could build in a mould of sufficient resistance, they profited by the simplification that rammed masonry afforded; in all other cases they abandoned its use.

This explains, without its being necessary to add to the above simple elucidation of its consequences, the use of rammed masonry for the body of foundations built in trenches, and it also explains its use in walls with heavy cut-stone revetments; while in ordinary walls, the revetting being too thin and weak to afford sufficient resistance to the outward thrust, ramming could not be applied, for it needs only a glance at the revetments of such walls to perceive that it would be impracticable.

The revetment of an ordinary rubble wall was composed of very small cubical stones arranged in such a manner as to make by their joints elegant and varied figures, or more often it was of triangular bricks arranged as shown in Fig. 4. This system gave, with but slight expense, a method of obtaining a very strong bond between the bricks and the core of rubble, but the revetment, far from being able to resist any outward thrust from this core, was only maintained by its adherence to it. It was only an envelope, excellent for protection against the rain, but absolutely incapable of resisting any outward

thrust exercised by the filling; and to apply to this filling the methods used in building the tombs of the Appian Way (Fig. 1) was to become involved in the complications which temporary work invariably brings.



FIG. 4.

The rule agrees, it would seem, with the facts, and it equally agrees with the allusions to the subject found in ancient documents. Vitruvius speaks of the employment of rammed masonry in two cases only; once when he recommended it in the construction of subterranean cisterns, giving the method as follows (Book VIII., last chapter): A trench was cut in the ground with its sides following the faces of the cistern walls, and in it was rammed either beton or rubble, such as we have described; then the core of earth was removed and the bottom laid and rammed down. The second example is in reference to the laying of the rubble filling between two stone facings (Book II., Chap. VIII.), and in each case it is evident that no preliminary casing was necessary. Thus we find in these writings a new verification of a theoretic rule which, however, is sufficiently supported by an examination of the ruins. There is no doubt that the Romans were acquainted with and used coffering in building; among other very clear references, a passage in Varro (*de Re. Rust.* Lib. I., XIV.) shows that they used them at least for building enclosures of earth unmixed with mortar, such as could only be executed by using some sort of mould. Perhaps they extended this process in certain cases to masonry, properly so-called, but I have nowhere been able to point out with certainty its application, and if masonry involving the use of casing was employed by the Romans, I wish, at least, to show that it never was of sufficient importance to be called a general method.

I know that the exterior aspect of the walls of Roman edifices gives at first glance a certain appearance of truth to the hypothesis which would confound them with masses run into movable moulds. Many holes pierced these walls at different levels, and distinctly recall those which mark the crosspieces of the coffering in our constructions of *pisé*.

The moulds used in this sort of construction usually consist of two panels of planks resting on horizontal crosspieces, and kept at an invariable distance from each other by a simple expedient, of which the sketch (Fig. 5) is a sufficient description. The material of the

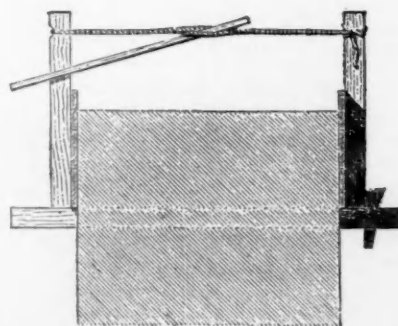


FIG. 5.

wall is thrown into this casing, and the crosspieces which support the panels are removed at the completion of the work, leaving holes entirely through the walls, which have quite the appearance of those seen in the Roman masonry.

An analogy of construction which one might be tempted to draw from this exterior resemblance would be, I think, a very doubtful one. It would be incorrect, in fact, to think that these horizontal holes always completely pierce ancient walls. If the wall is thin, as in Hadrian's Villa, and the radiating walls of the Coliseum near the arena, they go quite through; if the wall is thick, as in the Baths of Caracalla, Basilica of Constantine, the Temple of Venus and Rome, and the Baths of Diocletian, they usually stop at a slight distance from the surface, and nothing authorizes us to conclude that the middle portion was afterwards filled. It seems, then, quite natural to believe that these holes contained, not the crosspieces of a coffering used as a mould for the rubble, but the crossbeams of scaffolding.

They are in fact nothing but the holes, in which the joists which held the footboards were thrust, either completely through the wall or partially so. These holes show the exact print of the joists which formerly filled them. One may see from their crooked imprints how imperfectly squared and dressed was the material of the scaffolding, and the spacing of the holes, so often unequal, shows the rapidity with which the joists were laid, the economy of time and of care with which the entire scaffolding was built. But that which above all is most striking is the irregularity of the imprints of the scaffolding; they are sometimes so strangely twisted that one can safely affirm that the wood was never removed from them, a condition that is very marked in the wall of an ancient edifice, a square tower called the Temple of Janus, which still is to be seen near Autun, of which I give a horizontal section in Fig. 6.

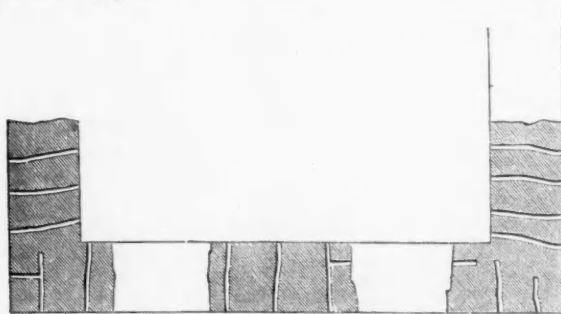


FIG. 6.

More or less marked, according to circumstances, the practice of abandoning the crosspieces of the scaffolding in the rubble seems to have been constant among the Romans. They used pieces of small value to carry the footboards, and, in place of removing them at the completion of the work, they were content with chopping them off or sawing them flush with the faces of the wall, removing only the ends. The parts left thus buried in the masses of masonry rotted in the course of time, and left empty the places they had occupied.

The presence of these empty holes in the mass of the walls seems a detail of little value, and an explanation of them has of itself but a secondary importance; but as several observers have believed that in these cavities lay the indications of a system of construction quite different from that which I have described, it will perhaps be profitable to dwell longer on the origin and the rôle I assign to them. Let us suppose, for the moment, that the wood which had lain in these holes in the ancient walls had been removed; the spaces left by its extraction would have been stopped up by some filling or other of which some indications would still remain, for it would be protected from the rain and would have no tendency to slip out, the sills being horizontal.

Assuredly the filling could be found if it had ever existed; and the only explanation of its absence lies in admitting that the joists of the scaffolding remained in the walls and rotted in place, and this admitted, it becomes easy to imagine the original construction of the Roman walls; and in Fig. 7, a theoretic drawing, it is fully shown. I have endeavored, in drawing the figure, to show plainly the appearance of the built-in joists during different periods and at the completion of the work. It is unnecessary to dwell on their rôle before the work was completed, the figure being quite explicit enough in this

respect; the important fact which I wish to point out is their abandonment in the walls. The practice of leaving pieces of scaffolding in the walls may appear strange, not being in accordance with modern construction, but it is assuredly too practical to be regarded as unlikely.

First, in sawing the joists off flush with the walls instead of removing them, all danger of unsettling the masonry which the extraction of them would necessarily have caused was avoided, for it would have been necessary, in order to remove the pieces of wood so often twisted and crooked, to drive them through by blows or to pull them through by main strength, running the risk of weakening the bond of the yet unset mortar; but once the idea of withdrawing them was given up, all chance of this was avoided, and, moreover, the loss of these sticks did not involve, to tell the truth, a great expense, for, as we know, they were of less than mediocre quality.

But the principal merit of burying the beams in the wall was that of tying together the facings, these fragments of wood reaching from facing to facing, recalling, by their position, the long transverse stones which masons place as bondstones in walls of dressed and squared material, and this is not a fanciful comparison; the analogy is exact in every point, and the rôle of the joists extending through these rubble walls is precisely that of the headers in walls of cut stone, the form of the pieces, their position, their tie in both faces of the walls, being similar in the two cases. If, moreover, the testimony of the ancient authors is thought necessary for concluding that similitude of form implies analogy of function, a clear passage in Vitruvius will verify the hypothesis I have enunciated. It has reference to the building of a city: "In the thickness of the rubble," he says, "it is advisable to build in joists of olive wood, slightly charred, traversing the mass from side to side in such a manner as to join together, to tie, as it were, the two faces" (Book I., Chap. V.). And Vitruvius, after having explained his preference for olive wood (which he says dampness rots less than others), adds, "not only fortifications but also foundations and walls of great thickness, tied as just described, will long withstand causes of deterioration."

I have no need to add to such a declaration. Far from weakening our explanation, Vitruvius formulates and completes it; the ancients had so little idea of removing from the walls the timber of the scaffolding incidentally built in them, that they finally adopted the practice of building in, across the masses of masonry, headers of wood, even when there was no need of this, burying the joists in the thickness of the wall in order to carry the scaffold boards.

The headers of wood thus formed a first bond in the rubble, but the Romans used another as much more efficient as it was more costly. It was to build across the wall at different levels isolated courses of extremely large bricks, whose effect was to tie together the two faces; the bricks they employed for this purpose were ordinarily squares of sixty centimetres (about two ancient feet) on the side, and of four to five centimetres in thickness. I have endeavored in Fig. 7 to show the rôle and position of these bricks in the ancient walls. They formed, as it were, levelling beds, which may be compared to horizontal layers of tiling imbedded in the masses. In the greater number of walls these beds were of a single thickness; sometimes two or three layers were directly superimposed, but this was rare; the ancients more often contented themselves with single courses of squares of baked clay traversing the walls horizontally at intervals of between 1.50 metres and 3 metres, the entire wall between two layers of the large bricks consisting of rubble laid without ramming; in other words, the mass of the wall between two successive levelling beds was composed of alternate layers of mortar and of broken stone, enclosed by slight facings of triangular bricks or of small stones.

The remarkable size of the bricks composing these isolated courses, which recur in ancient masonry at regular intervals of about every twenty layers, for example, is sufficiently explained by the bonding qualities which the ancients attributed to the courses themselves. It does not seem as easy to justify the extreme smallness of the stones composing the intermediate courses. It is easily understood that the Romans broke their stone up in very small bits when it

THE BRICKBUILDER.

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PUBLISHERS' STATEMENT.

No person, firm, or corporation, interested directly or indirectly in the production or sale of building materials of any sort, has any connections, editorial or proprietary, with this publication.

THERE is one principle in the designing of brick details that we have persistently repeated in these columns, that special contributors have time after time dwelt upon, and that has been supported by almost every successful design that we have published. Projections must be kept small. We have houses in all our cities and towns where brick has been used to produce ornamental effect, that are made hideous by the extreme projection of the details. Panels are formed by projecting or recessing headers half their length. Surface patterns, in certain lights, throw heavy shadows, which give them prominence out of all reason. The trained men in the architectural profession seldom make these errors, but there are architects, or builders, in all our cities, and particularly in our large ones, who are constantly failing in this direction, as thousands of recent buildings testify. Surface patterns, as a rule, should not be too prominent, and usually, varying the color of the mortar in which they are laid, or sorting the brick into light and dark shades, will be sufficient for any surface decoration. In cornices, where projection is desired, it is almost always safer to adopt some corbelled treatment, building the corbels up by slightly projecting each course. Where dentil courses are used considerable projection is necessary, but this is a special class of detail.

ANOTHER principle fully as important, but which applies in general to all architectural design, is that of the restrained application of detail. Wall surfaces should be kept quiet, treated broadly and simply, the detail applied sparingly, to string courses and cornice, and, perhaps, to openings; but it is often better to treat these plainly, giving attention to their proportions and relation to the wall surface. One of the best examples we know of as illustrating this principle is the Ludlow, in Boston, designed by C. Howard Walker. A photograph of this was published in our April number, last year (page 32). The openings of the first four stories are perfectly plain holes in a perfectly plain wall. The fifth story is treated with arches, in which buff bricks are used with the red, and above this is a very low frieze story, mostly of buff brick with disks of marble to give spots of brighter color. The value of the two upper stories depends very largely upon the

simple treatment of the whole building below them. It is so well done that one seldom thinks that this is nothing but an "ordinary common brick" building.

CONFLICTING reports as to the condition of the building business come to us from all parts of the country, but recent calls upon the brick and terra-cotta manufacturers, not only in the East, but in the West, found most of them fairly busy, while some had all the business they could carry. That all look for constant improvement is shown by the great increase in our advertising business. We are gratified by this increase, not so much on account of its pecuniary value, as for the fact that it proves that we are satisfactorily filling the special field we have chosen. When a class publication wins the support of level-headed, unsentimental business men, it is pretty good evidence of merit, and it is therefore with no little pride that we point to the advertising pages of this number. With the orders received too late for this issue, we have an almost complete line of advertisements of Eastern brick and terra-cotta manufacturers. Of the latter, only two are conspicuous by their absence, at the time of writing, and we have every confidence that the June number will contain their announcements. It will thus present a complete line of the advertisements of architectural terra-cotta so far as the Eastern field is concerned.

WE desire to call the attention of the practising architects among our readers to the educational value of the reprint of Street's "Brick and Marble," and the translation of Choisy's "L'Art de Bâtir," to the students and draughtsmen in their offices. The former work is, in its way, a classic; the latter, a standard authority. Either of them, if obtainable at all, will cost many times our subscription price. We therefore suggest that for their own benefit the students in your offices have their attention directed to these two features of the current volume, and be informed of our special rates to clubs of five or more, as advertised on page x. Our main object in publishing these two works is to add to the value of THE BRICKBUILDER as a paper for students to read, and we request your co-operation in placing it before them in this light.

IT is comparatively easy to secure for publication good mercantile work in brick, or city residences, schools, and public or semi-public buildings. But it is another matter to locate detached residences of moderate cost which are good examples of the use of brick. There is every reason why such work should be done, and we think it is done, but we know of no way of finding it except by asking all our readers who have done such domestic work in brick, or know of good examples, to send us photographs, sketches, or even blue-print plans, and elevations of their own work, and put us in the way of securing the other work. THE BRICKBUILDER has been sadly lacking in designs of this character, and we make an appeal to our readers to supply the deficiency.

WE also ask the assistance of our readers in another direction. Thus far, in our reprint of Street's "Brick and Marble," the illustrations have been limited to those of the original work. Now that the writer is taking up the cities especially noted for their brickwork, we desire to supplement the original illustrations with sketches and photographs. Verona will be described in the next three issues, and contributions of sketches and photographs will be thankfully received, well cared for, and returned as soon as reproductions can be made. Sketches of detail are particularly desired.

THE following letter we recommend to the careful consideration of all manufacturers desiring to introduce their materials into the buildings of Central Massachusetts:—

SPRINGFIELD BOARD OF TRADE.

SPRINGFIELD, MASS., May 4, 1894.

EDITOR OF THE BRICKBUILDER.

Sir,—We have the pleasure of having THE BRICKBUILDER on our tables, and also of reading the same. I notice that in your March number you refer to "standing exhibits" of building materials as being very much superior to having them scattered among the different architectural offices in any place, and in this connection will say that we have formed in our Board of Trade and Builders' Exchange rooms an exhibit which promises to be very successful. We have divided the same into two parts: one of which, coming under the Board of Trade, will contain an exhibit of all articles manufactured in Springfield; the other, which is held in connection with the Builders' Exchange, is composed of materials which come into the construction and decoration of buildings.

Among the exhibitors in this line are Fiske, Homes & Co. and W. H. Gates of your city, and it occurred to me that an editorial mention in your most excellent publication would be of advantage, not only to us, but to you as showing progression in the lines which you advocate.

We are doing considerable building in Springfield at this time, such as the Young Men's Christian Association building, two new blocks on Main Street, one, a hotel, the other, an office; also a public market is being agitated, and several blocks are contemplated. It might be that you could call attention to this exhibit, which I believe is unique as far as Boards of Trade go, and call the attention of your advertisers and patrons to it. We should be pleased to reciprocate any time when possible. Our Board of Trade is very active, comprising about three hundred members; and the rooms, being open from seven in the morning till nine at night, have a large number of visitors, and are headquarters for meetings of almost every kind.

Trusting I may have the pleasure of hearing from you, I remain,

Yours very truly,

W. A. WEBSTER, *Secretary.*

The above letter is also worth consideration as an index, to some

extent, of the way THE BRICKBUILDER is fulfilling its mission. Our monthly correspondence, largely inquiries concerning various clay materials, special forms of construction, particular information as to the planning and design of certain classes of buildings, would fill a number of the paper, and this has by force of circumstances turned our office into a sort of information bureau. There are many instances where the sending of a marked copy of some issue suffices to answer the inquiry; but occasionally, as above, the full letter requires publication.

Manufacturers who are interested in the Springfield Board of Trade's communication should bear in mind the value of this small part of our circulation, *i. e.*, to Boards of Trade, Engineering and Architectural Clubs and Societies, and Builders' Exchanges, where a single copy of the paper finds scores of readers. No manufacturer of clay building materials, of cements and mortar colors, or of the machinery necessary for the production of such materials, can afford to be without liberal representation in our advertising columns, which are as much consulted by our readers as the text pages and plates. To emphasize this, we submit the following letter, the writer of which needs no introduction from us to any reader in the profession or building trades:—

ST. LOUIS, May 14, 1894.

THE BRICKBUILDER, Boston, Mass.

Gentlemen,—I must again compliment you on your illustrated monthly magazine. Your last issue is a pronounced success and speaks volumes in favor of your energy and push.

Mr. George P. Standuhar, architect, of Rock Island, Ill., was in my office a few days ago, and, in referring to your journal, remarked that it was doing the bricklaying and brickmaking interests much good, to which I readily assented.

I am especially pleased with the manner in which you have dressed up my "ad.," and will be glad to have you continue same in its present style until further notice from me.

Yours truly,

ANTHONY ITTNER.

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TERRA-COTTA IN SKELETON CONSTRUCTION.

(See Plates 35, 38, 39 and 40.)

IT is the intention in this paper to briefly illustrate some of the phases of modern office-building construction. We will consider first the exterior walls—not the foundations, not the interior partitions and columns, not the floor arches (except incidentally), and, except in a general way, not even the steel columns and beams in the exterior walls.

There is much known and much yet to be learned concerning the comparative economy of various kinds of columns under both general and particular conditions, and much yet to be proved concerning the comparative worth of Z bar columns, and plate and channel columns; of the Phenix, Larimer, or Gray columns, etc. Much thought and weighing of considerations is needed in deciding on the kind of columns to be used in each particular building designed. But at this moment we are concerned with the kind of steel construction only as far as it affects or is adapted to its masonry covering. The illustrations will show how brick and terra-cotta form that covering, and how materials other than brick and terra-cotta, such as stone and iron, are used in skeleton construction, either supplementing the former or by contrast showing their inferiority to terra-cotta.

The first structure chosen for illustration is the New York Life Building, corner La Salle and Monroe Streets, Chicago. This is one of the most lately completed of the large office buildings, and is claimed to be an example embodying the most advanced ideas.

A statement of the time occupied in erecting this building is interesting, as it is due largely to the principles of construction. The rapidity of erection has a double interest when the owners of an office-building site calculate the interest on an investment of from \$1,000,000 to \$3,000,000 while it stands without income-producing power.

The New York Life Building replaced a fireproof building six stories high, which stood alone in that region of the city uninjured through the great fire of 1871. Tenants had moved out and the work of razing the old building began . . . May 4, 1893.

Laying out boxes for footings for the new building was not begun till . . .	July 31, "
The first basement column was set . . .	Aug. 17, "
Finished setting fifth floor beams . . .	Sept. 2, "
Began setting tile floor arches . . .	Sept. 5, "
Began setting terra-cotta . . .	Sept. 18, "
Began setting attic floor beams . . .	Sept. 21, "
Began setting window frames in fourth story . . .	Sept. 21, "
Delayed for steel and granite . . .	Sept. 23, "
Began setting enamelled brick, in court . . .	Sept. 27, "
Finished setting roof beams . . .	Sept. 29, "
Finished riveting roof and cornice steel work . . .	Oct. 3, "
Finished laying roof and began plastering . . .	Oct. 9, "

Badly delayed in past ten days for lack of terra-cotta, granite, and enamelled brick.

Terra-cotta began coming again . . .	Oct. 19, "
Began setting frames for interior tile partitions, third floor . . .	Oct. 23, "
Granite arrived in Chicago . . .	Oct. 24, "
Began setting window sash . . .	Oct. 30, "

Finished setting granite . . .	Nov. 6, 1893.
Finished setting tile floor arches . . .	Nov. 9, "
Finished setting terra-cotta . . .	Nov. 11, "
Began marble work in main entrance . . .	Nov. 28, "
Made fire under boilers . . .	Dec. 1, "
Turned steam on building . . .	Dec. 2, "
Began interior finish . . .	Dec. 6, "
Began running freight elevator . . .	Dec. 11, "
Finished plastering up to eighth story . . .	Dec. 14, "
Plastering complete except patching . . .	Jan. 30, 1894.
First tenant moved in in . . .	March, "
Several tenants moved in about . . .	April 10, "
Only fifteen rooms vacant in entire building . . .	May 10, "

Facility of construction is due to steel work being made at shop ready for erecting, and to the fact that masonry can be building in several stories at once. For example, the terra-cotta exterior walls were begun at the fifth-floor level before any of the granite of first three stories had begun. The drawings published herewith show quite clearly the construction in detail. Only a brief description and some general observations will be attempted here. The building is twelve stories high, beside a basement and a six-foot attic space. The first three stories of the two street fronts are faced with granite. The other stories are entirely terra-cotta. The alley and court side of the building is faced ten feet high with cast iron, and above that, to the top of the building, with American white enamelled brick, the sills, mullions, and lintels being white glazed terra-cotta to match the brick. The fourth side, or end of the building, is a party wall twelve inches thick, built of tile and carried by beams at each floor. The building is 80 feet by 141 feet 5 inches in plan, the main cornice is 150 feet above the sidewalk, and the height of the office stories is 10 feet in the clear.

After the general sketch plans and elevations of an office building are decided upon, a large force of men can start on the working drawings at once. While engineers are making their calculations and framing plans, and designers are working on the elevations, and at the same time making wall sections, others are drawing general plans. After determining generalities in the way of floor and column loads, approximate general sizes of beams, girders, and columns, and method of wind bracing, one of the first necessities is to fix the relation of centres of columns to "building line." The city ordinances fixing minimum thickness of brick, terra-cotta, tile, or stone around a steel column, and the conformation and depth of reveals of curtain and pier walls, all have to be considered; and modifications, both in the steel construction and in the exterior design, have to be made, each in turn due to requirements of the other. If stone is used, greater thickness must be allowed than is needed with terra-cotta or brick.

With all that has been done and said regarding architectural design and decoration on skeleton construction, progress in that respect is sure to continue. But the matter of fire-proofing is still more important, and there is room for much improvement in methods of protecting metal columns and beams. It is coming to be recognized that a double covering is important, so that, if the outer layer becomes loosened by water and fire, a second layer will remain. In view of the poor resistance of stone exposed to fire, it would seem particularly important to protect the steel with fire-clay tile back of the stone;

LIMES AND CEMENTS,

MORTARS AND MORTAR COLORS.

MODERN PLASTERING.

TREATING THE VARIOUS KINDS OF LATH AND PLASTER; THEIR RELATIVE COST AND HOW TO ESTIMATE.

THE question which always arises in the construction of a modern building is, What kind of lath shall we use? or if, indeed, we are to use any. In some of the large cities where every inch of space is desirable in a building, the plastering is applied directly to the bricks, but in such cases the mortar joints should be left very rough to allow the plaster to adhere more fully; the walls should be washed free from dust, and if the bricks are very dry they should be dampened as the plaster is applied. There are, however, several objections to this style of plastering, although the cost is considerably less, the most prominent being its liability to gather dampness.

Wooden lath will cost us less than metal and in ordinary cases are perfectly satisfactory. Fourteen bunches of lath and five pounds of nails will be required to every one hundred yards of plastering, and a good lather will put on from fifteen to twenty bunches per day.

But if our building is to be perfectly fireproof, we must use metal lath, of which there are several distinct patterns, the two principal ones being the expanded metal, and wire-cloth lath. As compared with wooden lath, the advantages of expanded metal lath are that it affords a better key for the plaster, is absolutely fireproof, and the ceilings and walls will never crack. The price of this lath is twenty cents per square yard, and it will cost five cents per yard to apply it to the work; about the same amount of plaster will be required as on the wooden lath.

The Kelly corrugated wire lathing consists of flat sheets of wire cloth with ribs or corrugations running lengthwise at intervals of six inches; the depth of the corrugations three eighths of an inch. These sheets are applied directly to the under side of the floor timbers for the ceiling and to the partitions for the side walls and secured with wire staples, thus avoiding the use of furring.

Another style is the stiffened wire lathing, this being a wire cloth, into which, at intervals of seven and one half inches, V-shaped strips of No. 24 sheet iron are woven. This gives a smooth, firm surface for plastering upon, and is secured by driving a nail through the bottom of the V, and is applied directly to the timbers with a stretcher. This lath will cost us a trifle more than the expanded metal lath, but it is the verdict of some of the leading architects that this is the best fireproof lathing in existence.

And now, having examined the various kinds of lath, let us proceed with the plastering.

The plastering of the inside of buildings, whether done on wooden or metal lath, brick or stone, usually consists of three separate coats of mortar. The first, or scratch coat, is put on roughly, and if common mortar is used should be pressed on with the trowel with sufficient force to enter between the lath and form a clinch. If adamant or other patent plaster is used, the first coat will not require to be forced through as much. The second coat, or brown-ing, is put on about three eighths of an inch thick, and, should the scratch coat have become too dry, it may be dampened slightly. This coat should be well screeded, as all walls are generally warped or out of line, and to remedy this screeding is resorted to.

The third coat, or hard finish, consists of one part plaster-of-Paris to two parts lime putty without sand; for sand finish add white sea sand. Hard finish works easily, but is not as good as a stucco finish for walls intended to be painted in oils. Stucco finish is made of one part of lime to two parts of sea sand and marble dust, and should be worked with a float in a circular direction, then polished with trowel and brush. Any one of these third coats may be polished more or less, according as it is to show or be painted or papered.

Another and cheaper mode of plastering is to put on but one coat of brown mortar, and finished with a coat consisting of six parts of putty to one of sea sand, and should be skimmed on very thin, while the first coat is yet green, therefore its name, green-skin finish.

There has lately been introduced an entirely new method of wall and ceiling plastering, which claims some advantages over the old method, namely, ease and speed in covering, and in securing the plaster against falling and fire. Instead of spreading the plaster on laths, it is prepared in solid slabs or blocks, and then nailed to the joists and studs. These slabs may be made of any convenient size or shape, and may be prepared by a skilful workman in the following manner: Select some smooth, hard surface, and set up sloping sides to give the slabs a bevelled edge. Now pour in a thin layer of plaster-of-Paris of such consistency that it will run readily to the mould; upon this, and securely bedded into it, spread a piece of canvas or burlap. Laths are then laid along two opposite sides of the slabs, and over all is spread a thick layer of common plastering mortar, with a little plaster-of-Paris added to increase its setting qualities. However, before it sets it should be brushed over with a coarse broom to produce a rough surface, which forms a key for the finishing coat of mortar. When the mortar has set, and the slab is dry and hard, it is ready to raise to its place and fasten by nails driven through the laths. The finishing coat may now be applied in the usual manner, filling up the cracks between the slabs, so that it presents when finished a hard, uniform surface.

Having now examined the different systems of plain plastering, let us look into the ornamental decoration, such as cornices, mouldings, arches, centrepieces, etc.

In order to execute a cornice of a given pattern it is first necessary to prepare a mould of the several members, which is generally made of metal indented so as to represent exactly the various forms and projections of the respective members, and fastened into a wooden frame with a handle. Two workmen are necessary to run cornice properly. Should the cornice be of unusual size, such as are sometimes seen in halls and large dining-rooms, it is necessary to frame them by nailing brackets to the wall, about sixteen feet apart, to which laths are nailed. Then cover the whole with brown mortar, allowing one inch for the putty which forms the cornice.

Before using the mould, a screed should be fastened on the wall and ceiling of putty and plaster wide enough to admit the top and bottom of the cornice to be formed. Fit the cornice mould squarely into the angle at one corner of the room, and mark the outer edge of the cornice on the ceiling screed; also make a mark at the opposite angle, and from the two marks obtained strike a dark chalk line. Now nail a pine straight-edge, one half inch by three inches, on the wall screed, have the under side of the mould set squarely upon this,

and have the upper outside edge of the mould in line with the chalk-line on the ceiling. This forms a guide to run the cornice.

All now being ready, mix lime putty with about one third plaster-of-Paris and of a semi-fluid consistence by the addition of clean water. One of the workmen then spreads the prepared putty on the surface where the cornice is to be, while his companion applies the mould from time to time to determine where more or less of the material is required. When all parts of the mould are apparently filled, the mould is worked backwards and forwards, at the same time held closely to the wall and ceiling, and by this means the superfluous material is forced out, and the outline of the cornice completed to the required form.

Sometimes it is necessary to repeat this operation when the filling is deficient in the former application. If the cornice is large, it is necessary to use three or four moulds in succession. Great care should be exercised in finishing the mitres at the angles, and it requires skill and good taste.

Additional ornaments may be made for enriching the walls by making a model from clay or other tractable material from designs made for the purpose. Skill, taste, and a large amount of perseverance are necessary to insure success. Having finished the model, it should be left until it hardens, then oiled thoroughly all over with sweet oil, and placed in a wooden box. The next operation is to pour melted wax and rosin into the box until the model is covered, then leave it until it is thoroughly cold and hard: turn upside down and

the wax will readily slip from the clay mould and becomes a mould for future castings. The casts should be made of the purest and finest plaster-of-Paris well saturated with water, and the mould must be well oiled or the casts will stick and be liable to break in removing.

Gelatine is widely used to make the above ornamental casts. Take good glue, well soaked and swelled, and pour off the excess of water, and add glycerine six times the weight of the dry glue used. Heat and evaporate water sufficient to make the substance the proper consistency for use. Modelling clay is made by kneading dry clay with glycerine instead of water.

We have now considered the most common modes of plaster ornamentation, although there is practically no limit to the decorations which a skilful and ingenious workman may produce.

Not the easiest task in connection with this work is the estimation of the cost. At the present rate of wages, mason at \$3.75 per day, and laborer, at \$2, and the current rate for material, plastering is taken for from thirty cents to forty-five cents per square yard, according to the lath, finish, etc. Soffits, friezes, etc., are taken by the foot, according to description. Measure raised panels extra by the superficial foot. Take the mouldings or the panel by the running foot.

Cornices are generally taken by the foot. If the girth of the mouldings from the ceiling to the wall line is under six inches, take it by the running foot; if over six inches, by the superficial foot. The cost of cornices and mouldings varies according to the size of the moulds, and are taken for from twenty-five to fifty cents per foot.



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Plaster arches are taken by the piece, and the contractor must place a price upon them from former experience, but in ordinary cases they run from three dollars to twenty dollars, and even more for very stylish or ornamental patterns.

Trusses, centrepieces, etc., are bought by the piece, and at the present time from one dollar to fifteen dollars.

Having thus briefly followed and explained the different stages of the plasterer's art, we trust the reader, whether master or apprentice, will have received some profit thereby, and have gained a better insight into the methods of modern plastering.

New Britain, Conn.

R. N. BUELL.

PRACTICAL OBSERVATIONS UPON PORTLAND CEMENT.

(FROM A PAMPHLET ISSUED BY THE LAWRENCE CEMENT COMPANY.)

TRUE Portland cement requires but little water to make a good mortar.

During the mixing with water, Portland cement undergoes a diminution in volume of $\frac{1}{3}$.

Portland cement contains after consolidation about ten per cent of water chemically combined, and has a specific gravity of $2\frac{1}{2}$.

One volume of Portland cement will take $\frac{3}{10}$ to $\frac{4}{10}$ volumes of water.

If a greater quantity of water is necessary to make a proper mixture, considerable heat is developed, indicating the presence of an excess of free lime.

If a smaller quantity of water is required, it is evident the cement was over-burnt, or too old, or already surcharged with water or carbonic acid.

Cement can be spoiled by a deficiency of water as easily as by an excess.

One cement may give the highest results with eighteen per cent (by weight) of water, but be totally destroyed by adding only sixteen per cent of water.

The greater the increase per cent between the seven day and thirty-day tests, the stronger and harder is the cement likely to become. This increase should be at least twenty-five per cent.

The fineness of Portland cement when ready for market should be such that not less than ninety per cent of it will pass through a wire sieve of twenty-five hundred meshes to the square inch.

The finer a cement is ground the more bulky it becomes, and the less it weighs by measure.

It is only when mixed with sand that the most important cementing properties of Portland cement can be appreciated. This power of *uniting* other substances is totally distinct from the ultimate strength the cement attains.

Two per cent additional water to a cubic yard of moist sand will decrease its weight eighteen per cent.

The simplest way to ascertain the measurement of the interstices in loose building sand is to fill, with dry sand well shaken down, a vessel of the same capacity as a cement barrel, and then pour in such a quantity of water as will fill all the spaces between the particles of sand.

The proportion of water used for this to the quantity of sand gives the measure of the voids in the sand.

From various experiments in this direction, it is definitely determined that the void spaces in medium coarse building sand amount to two fifths of the volume; so that two barrels of Portland cement may be judiciously mixed with five barrels of dry sand. If the sand used is damp, it will not be wise to use more than three barrels of such moist sand to two barrels of cement.

Cement mortar is said to have *set* when it has lost its plasticity and becomes so hard that its form cannot be changed without breaking.

A true Portland cement is classed as *slow* setting when it takes over a half-hour to harden.

The hardening process, which takes place when cement is mixed with water, has been explained in several ways. Most authorities ascribe the solidification to the formation of calcium silicates and aluminates, or else a bibasic compound is formed of double silicates of calcium and aluminum, which contain water of crystallization.

As to the manner in which these substances are formed, some hold that it is in the process of burning the raw material, and exists in the anhydrous condition of the dry powdered cement, immediately crystallizing on the application of water.

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1 day in air, 6 days in water,	-	-	400 lbs.
1 " " 27 " " " "	-	-	500 "
1 " " 3 months in water	-	-	600 "
3 parts of sand to 1 of cement.—Adhesive test.			
1 day in air, 6 days in water,	-	-	125 lbs.
1 " " 27 " " " "	-	-	175 "
FINENESS.			
Residue on sieve No. 50,	-	-	None.
" " " 100,	-	-	10 per cent.
Passing through sieve No. 200,	-	-	65 "
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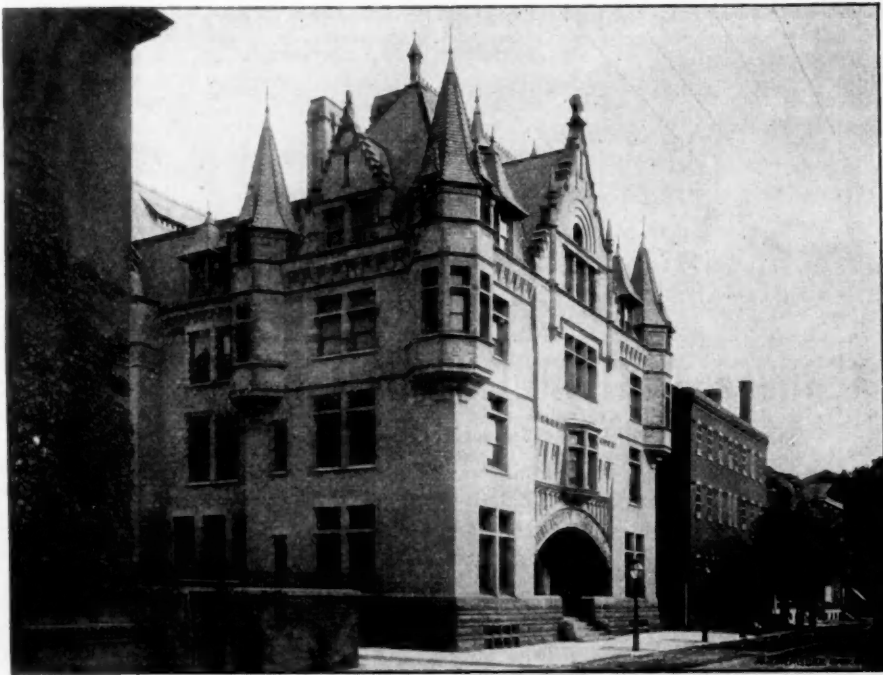
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BRICK, AND THE COMING MODEL CITY, SERIATELY
TREATED AND CONSIDERED.

By J. W. CRARY, SR.

THE cause and power of progress to greatness of a country lies in its inventive genius, skill, and energy. Egypt, Greece, and Rome were examples of this fact in ancient times. France, Germany, Great Britain, and the United States are the prominent evidences of this truism in modern times. When I say inventive genius, I do not use the term to imply only the invention of things in mechanics and physics, but as well in metaphysics.

THE GOVERNMENT OF THE UNITED STATES IS AN INVENTION.

True, it is the joint work of many great minds, and so is the invention of every great improvement of modern times, in mechanics and the sciences. It is a fact that not one single great invention known in our patent office is the product of one mind, independent of all others. The United States surpasses all other countries in inventive genius, but the field of invention is only fairly opened, and some parts of it have never been cultivated.

THE LAYING OUT AND BUILDING OF OUR CITIES YET ANCIENT IN
STYLE.

The renaissance of the Greek, Roman, and Gothic styles of building mixed with modern genius has given architecture an endless variety, a versatile taste, and, in some instances, a grotesque appearance. The Italian Renaissance is thought to be the most reasonable and tasteful, and that is divided into three distinct styles; viz., *Florentine*, *Roman*, and *Venetian*. Each of these styles has a peculiar excellence, and the architects of all other countries seem to have derived their chief inspiration from these Italian schools.

PROGRESS IN THE STYLES OF ARCHITECTURE HAS KEPT PACE WITH
MOST OF OUR MODERN IMPROVEMENTS, BUT THE PLANNING
OF OUR CITIES IS FAR BEHIND THE AGE.

The cities of the world are planned and built up to suit ancient institutions, ways, and means of life and business. Our cities are built to suit a niggardly economy in land, and room for proper business and living. Most all the true laws of health and the best social life are ignored or violated. Streets are narrow and buildings are high. Sunshine and pure air are practically excluded. Families are grouped together in "tenement houses," and the poor classes live like animals in a menagerie. In such a place the growing of health, moral character, and honesty, or self-respect and good intelligence, is impossible. These pest-houses of human degradation are shamefully tolerated in all of our large cities, the biggest cities having the greatest number and the worst style of houses. The houses called "stylish (or modern) flats" are alike detrimental to health or moral and social progress.

COMMONALTY IN FAMILIES AND INDIVIDUAL SELF-RESPECT ARE
INCOMPATIBLE THINGS.

It is the distinct, isolated individuality of family life that produces our great men and women. Heterogeneousness in the social contact of families is the inoculation of moral poison. The well-regulated, intelligent, separate, and distinct family is of itself a miniature nation. It represents a *minimum* of the *maximum* of the body politic. The increase of respectable families implies and assures the healthy growth and power of the general government. If it were not for the conservative power of our rural population, the moral equilibrium of the body politic would be destroyed, and the great cities, with their present plans for streets, buildings, and mode of living, left to themselves, would soon fall into despotism under the wealthy privileged classes.

WE WANT OUR CITIES BUILT SO AS TO ISOLATE AND INDIVIDUALIZE
THE FAMILY. HERE IS A NEW FIELD FOR INVENTIVE
GENIUS AND ENTERPRISE.

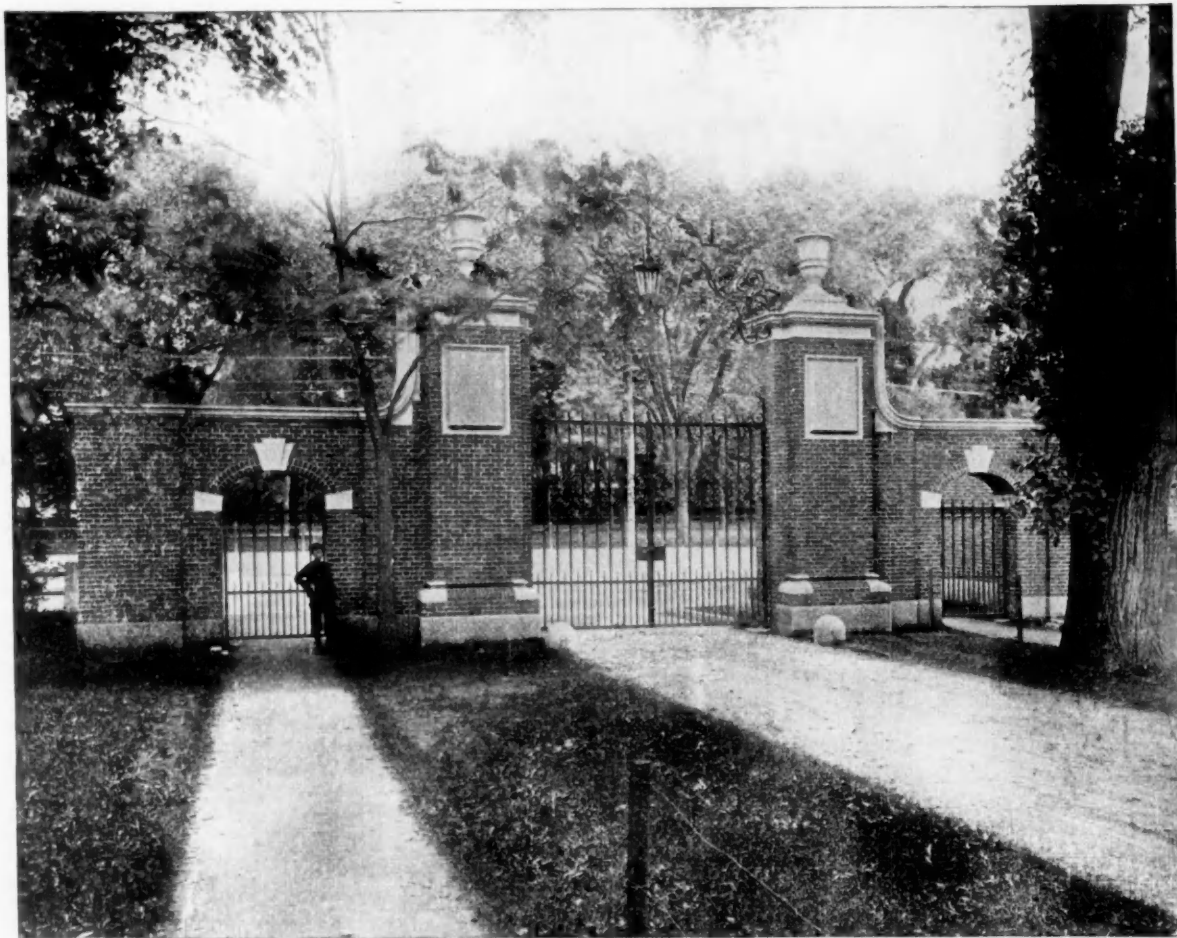
We want wide streets and detached, separate dwellings, not over four stories high. We want narrow parks in the centre of the streets. We want a perfect system of sewerage. We want a healthy and abundant supply of water. We want a sure and efficient plan for preserving cleanliness in all public and private places. However inquisitorial it may seem to be, every back yard, every water-closet, sewer, and privy of every house should be open to the inspection of proper and trustworthy officers. Streets should be paved with brick, made of suitable clay, and perfectly burned; and it is needless to say that all streets and private or public houses should be kept clean, with scrupulous, searching care.

ALL HOUSES SHOULD BE BUILT OF MATERIAL THAT WILL NOT RUST
OR DECAY.

Brick and terra-cotta (which are really the same in substance) should be used exclusively for building houses in a city. If these materials are used as they should be, and can be used, a building would be like a piece of good stone or earthenware. The walls, floors, ceiling, and roof could be cleaned and washed the same as an earthen plate or pitcher. Brick and terra-cotta can be made cheap, to suit every part and place in a house where wood or metal is now used, and it is only for the architect to study and plan his work to suit the adaptability of brick and terra-cotta to it in most all of its details. I will hereafter make suggestions in this line of thought.

WE WANT INVENTORS TO IMPROVE THE BUILDING OF CITIES.

Putting the sanitary question between open, airy-built cities and compactly built cities out of the way, and claiming that an openly built city would take up too much ground, and increase the distance and expense of travel, it is obvious and plain that cheap rapid transit, as we now have it, and still better, as we will have it, would much more



EXAMPLE OF COMMON HARD BRICK FOR ENTRANCE GATES.
SIDE GATES AT HARVARD UNIVERSITY, CAMBRIDGE, MASS.
McKIM, MEAD & WHITE, ARCHITECTS, NEW YORK.

than compensate for all the saving of distance in travel in a compactly built city. We can travel five times faster now in a city than we could fifty years ago, and it is reasonable to say that improvement in city travel will always be equal to the expansion and growth of the city, and the short and the long travel will always be the same in cost, without any serious or appreciable difference in time.

THERE IS A GREAT FIELD OPEN FOR CAPITALISTS AND INVENTIVE ARCHITECTS.

The planning and building of new cities, and extending old ones; the idea of saving ground or economizing space (and spoiling a city), in a vast country like ours, is so absurd and foolish that a sensible man or thinker would feel contempt rather than admiration to see little three or four acre patches of land (surrounded by narrow streets) all piled up with buildings from one to two hundred feet high, full of people, and mouldering goods, and all other things that befoul the air and breed disease, as well as to contaminate virtue and good morals.

Let our city builders resolve that we will modernize and Americanize our cities, go out into the suburbs, lay off the land so it will be about half streets and half building lots. Then absolutely forbid the use of anything for walls excepting brick and terra-cotta, and also that no "tenement houses," or "stylish flats," or excessively high houses shall be built.

BRICK AND TERRA-COTTA CHEAPEST FOR BUILDING HOUSES.

I have said that all other materials for building houses in a city than brick and terra-cotta should be excluded. I know that even fairly good lawyers would say that no law could be enforced that would give a monopoly to any one kind of building material, and that any fireproof material for building houses could be used, notwithstanding a law passed by a legislative body to the contrary. The common law says, "the law forms things for the good of the Commonwealth"; "private good yields to public"; "private loss is overbalanced by public good." Will any respectable lawyer dispute these quoted maxims? If brick and terra-cotta are really the best fireproof building materials, have not the inhabitants of a city the right to the best protection against fire? Is it not competent for the law-making power of the city to say that its citizens shall be entitled to use the best means for protection against fire? Not only the question of security from loss by fire is involved in building a city, but also the question of both private and public economy. I will here refer to one single item: viz., —

THE ITEM OF INSURANCE.

Although the general public do not study or concern themselves about insurance, it is a fact that the insurance policy is a species of gambling, in which the whole community plays a part. Every person who rents a house, or eats, drinks, or wears, and, I may say, many that